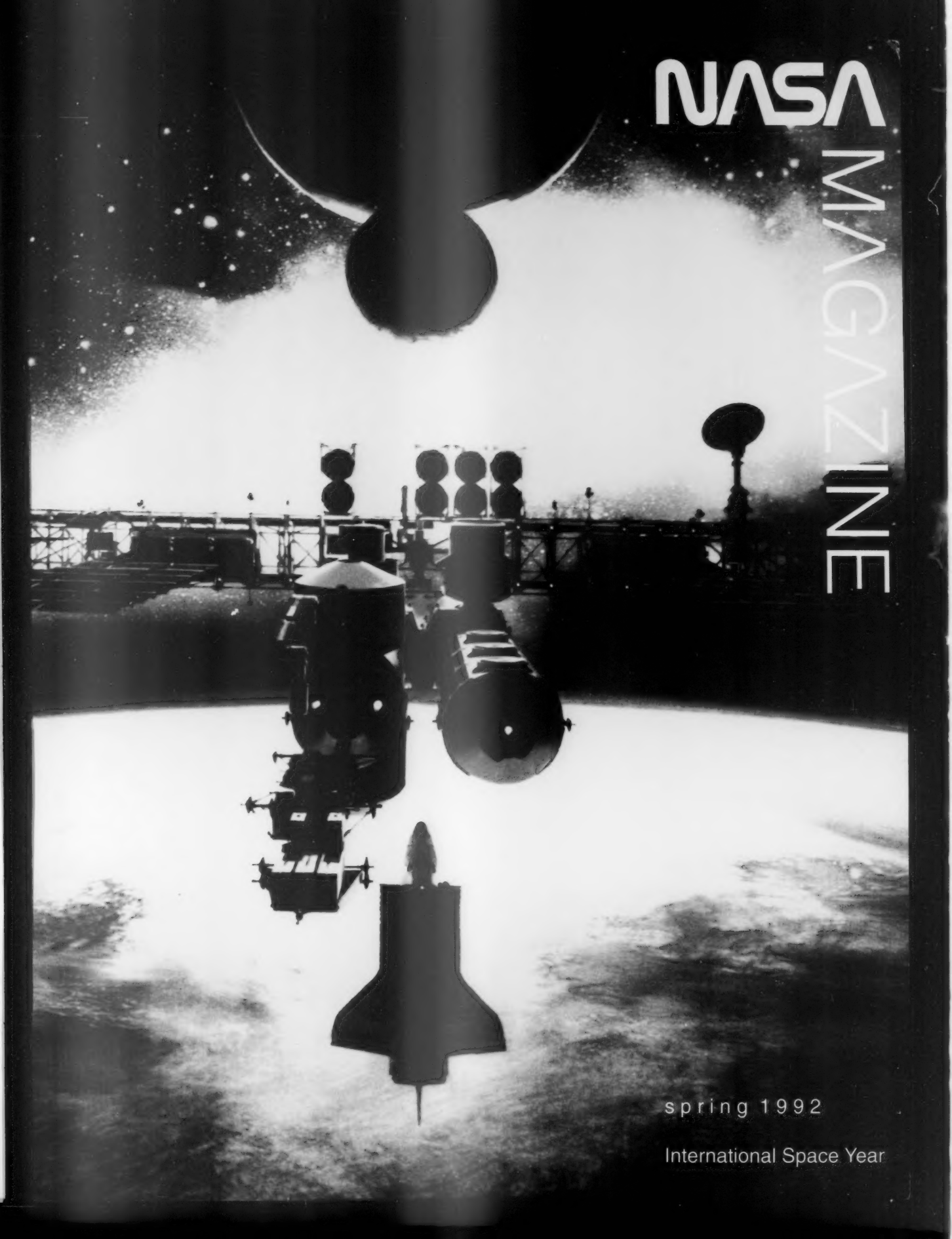

NASA
MAGAZINE
spring 1992
International Space Year

from the former administrator

Admiral Richard H. Truly stepped down as NASA's eighth Administrator on April 1. His departure marked the end of a career with the agency that spanned more than two decades: The "voice of Houston" for Skylab and Apollo-Soyuz; test pilot of the Enterprise; back-up pilot for STS-1; pilot of the second Space Shuttle flight (and first grandfather in space); commander of the eighth mission (first night launch and landing); and Associate Administrator for Space Flight until July 1, 1989, when he became NASA Administrator.

As Cody and I depart the NASA family, I can't resist leaving you with some final thoughts and challenges.

You must maintain the thrust of the programs in space science, aeronautics, the environment, human space flight and commercial development.

It is vital to remember that these programs are not just fancies of the moment. They are deeply rooted in our national fabric and codified in national space policies. They have been reviewed and approved by numerous presidents and congresses. They have been studied and reaffirmed by important commissions and advisory groups. They are bipartisan, national and international in scope, and span a diversified range of disciplines and technical arenas.

They are the product of broad and knowledgeable consensus. They are carefully planned so new initiatives will capitalize on previous discoveries and successes.

You must meet the challenge of continuous improvement. Common sense tells us that perfection is impossible. But if anyone has to strive for perfection, it is NASA.

You must work to restore genuine public enthusiasm for the space program to make it a national priority and, therefore, a budget priority.

There is no greater repository of space experience or of space technical expertise than in NASA. NASA is **filled** with ambitious, creative and highly motivated people. When Winston Churchill told President Roosevelt to give him the tools, and the Brits would do the job, he could have been speaking for us.

There is no better expression of American character than our exploration of space. People from other countries look at what we have achieved and the goals we intend to pursue there, and acknowledge that here is where you go to really understand Americans.

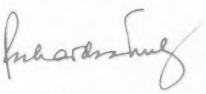
And what do they find when they dissect us and look for the essence? What do they find in this character that is shared by a polyglot of people of all races, colors, creeds and cultures?

What they find is this: Energy... a can-do spirit... a sense of adventure... an attraction to young people... technological literacy... altruism... optimism ...a compelling curiosity... and a great capacity for wonder and awe.

All of that is summed up in America's space program and in that community of people charged with carrying it out — the NASA/industry team.

These have been tough, exhausting, challenging and exhilarating years; years during which I have met and gained innumerable new friends who have given me unbelievable support; and years for which I am awfully proud. But the health of America's space and aeronautics programs is not in the hands of any individual. Without teamwork, the space program is nothing.

Keep it up!



Richard H. Truly

CONTENTS

spring 1992

features

10
ARTS AND SCIENCES
How the NASA Art Program documents major activities of America's aerospace program.

18
TO RUSSIA WITH...
A group of American artists gets a last snapshot of the former Soviet Union.

22
WINGS TO COME
In 2021 your plane may be able to get you to Japan in under 5 hours thanks to high-speed research underway at NASA now.

26
A WALK ON THE BEACH AT KSC
In among the Kennedy Space Center's high-tech launch pads you'll find one of the last unspoiled wildlife refuges in the East.

30
YES, VIRGINIA, THERE IS A SPACE MUSEUM
It's in Hampton, and it's now open for business.

33
NASA SELECT
The reviews are in: NASA's new TV programming is a hit.

departments

2
Spectrum

7
ISY Watch

8
Inside the Beltway

9
Off Hours

34
Center Select

36
As I See It

37
Countdown

COVER: Our cover features a painting by Houston artist Alan Chinchar, entitled "Space Station Freedom: Keystone to the Future." A frequent participant in the NASA Art Program, Chinchar describes his experiences as a space artist and his feelings about the cover art on page 21. The NASA Art Program story and related features begin on page 10.

NASA MAGAZINE

Acting Associate Administrator for Public Affairs
Sue Mathis Richard

Manager of Internal Communications
James P. Kout

Editor
Beth Schmid

Contributing Editor
Charles Redmond

Editorial Consultant
Tony Reichhardt

Editorial and Production Assistant
Sonja Alexander

Art Director
Robert Schulman

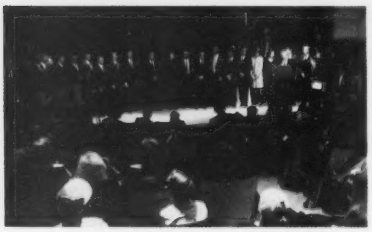
Staff Photographer
Bill Ingalls

NASA MAGAZINE is published quarterly by the National Aeronautics and Space Administration for the information of the Agency's employees. Contributions and comments are solicited from Headquarters and all field centers, and should be addressed to Editor, NASA MAGAZINE, Internal Communications, Code P-2, NASA Headquarters, Washington, DC 20546.

NASA MAGAZINE is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

NASA MAGAZINE is printed on recycled/recyclable paper.

President Bush, Vice President Quayle and Admiral Truly look on with 100 "young astronauts" as they talk to Discovery's STS-42 astronaut crew in ISY kickoff ceremonies at the White House on January 24.



Astronaut crews from four Space Shuttle missions help inaugurate ISY at White House ceremony, January 24.

Youngsters were asked to portray their vision of our future in space as part of the Young Astronaut Council/NASA children's poster contest called "Outer Sight."

President Bush Inaugurates ISY

President Bush, Vice President Quayle and NASA Administrator Richard Truly were joined by the astronaut crews of four shuttle missions and nearly 100 enthusiastic Young Astronauts for a January 24 International Space Year kickoff ceremony at the White House. The inaugural event featured the announcement by the Young Astronaut Council of a nationwide ISY educational program, including an ISY art poster contest that is expected to reach more than 100,000 American schools. The 100 Young Astronauts took the occasion to talk to the STS-42 astronauts orbiting some 150 miles overhead onboard Discovery.

One Thousand Teachers

During the week of February 16-22, 1,000 NASA engineers participated in National Engineers Week's Discover"E" Program, the largest student outreach effort sponsored by the engineering profession. Administrator Truly was one of a dozen distinguished "All-Star" engineers who shared his engineering and aerospace knowledge with a sixth-grade class on February 18.

Admiral Truly, one of National Engineers Week's "All-Star" engineer-teachers, shows a sixth-grade class how easy it is to build an airfoil.

But It Looked So Easy on TV

For those well-versed in the dynamics of live television, it should come as no surprise that Canadian astronaut Roberta Bondar's somersault in space during this year's Super Bowl telecast was accompanied by a host of logistical backflips here on Earth.

Bondar's somersault, part of the Discovery astronauts' coin toss demonstration, was seen by an estimated 120

Canadian astronaut Roberta Bondar, one of STS-42's crew members, flips over football before a Super Bowl audience of 120 million viewers.

million viewers around the planet during the Super Bowl pre-game show, and was the most visible in a series of special events beamed down from low Earth orbit during the International Microgravity Laboratory-1 mission in late January.

Pulling these events together was the job of JSC's Office of Public Affairs and its audiovisual contractor, the Media Services Corporation. The difficulties they encountered were, as people in the space business sometimes say, "non-trivial."

"Scheduling the Super Bowl downlink was a real challenge," recalls Jeff Carr, a JSC Public Affairs Officer (and son of Skylab astronaut Gerald Carr) who coordinated the event with the mission operations community. "There was no way to set an exact time with CBS Sports until after liftoff, and even then, what with the unique requirements of this flight, we weren't able to finalize things until the day before the game."

Among those unique requirements were Discovery's high-inclination orbit and the demand for a very stable attitude, which ultimately had an effect on the timing, length and quality of television opportunities. Normally, flight controllers would have scheduled a maneuver to provide the best geometry between orbiter antennas and the Tracking and Data Relay Satellite, and therefore the best television coverage. But since the IML mission was designed to provide an extremely "quiet" microgravity environment inside the Spacelab module, orbiter thruster firings had to be kept to a bare minimum.

While maintaining voice contact between the Shuttle and Houston, JSC Public Affairs technicians also assist CBS with Super Bowl highlights.

At JSC's Audio Control Room, the linkup with CBS Sports in Minneapolis was just as complicated. The shuttle beams words and pictures via TDRS to the NASA Ground Terminal at White Sands, New Mexico, but from there the audio and video take different pathways. Once at JSC, the audio is stripped out of the digital data stream and sent to an audio control room for release on NASA Select television. This conversion from digital to analog takes 38 milliseconds—one of several delays that have to be taken into account in order to maintain proper video and audio synchronization.

"Every satellite hop equates to a 256-millisecond delay between the video and audio," explains Mike Curie, lead sound technician for the audio control room, "but luckily every event was just a one-satellite hop. We also had to know in advance whether the signal was coming down via the Shuttle's camcorder system—which involves an additional 28-millisecond delay—or through the regular orbiter cameras, which is a 96-

millisecond delay. It gets interesting in a hurry."

Once at JSC, the audio then was sent to CBS. During this involved juggling act, the audio control room also had to maintain the ability for Mission Control to break in and talk to the crew if need be, and a complicated telephone hybrid system had to be patched in as a backup in case the primary circuits from NASA to CBS failed.

"There were more players in this lashup than in world hockey," said William Robbins, the JSC audiovisual manager, "but in the end we were able to give millions of viewers a brief glimpse of what living and working in space is all about."

No telling what Houston could have pulled off had the Oilers been playing in Minneapolis instead of the Bills.

Kennedy Men Pose for Charity

In order to raise money for the local Adult Literacy Program (while at the same time advertising the eligibility of a number of Kennedy Space Center male employees), Flash Productions—the home

KSC's Mitch Varnes poses for charity calendar, along with 11 other men.

business created by shuttle software analyst Cheryl Farmer to market the calendar—produced a 1992 calendar to "change public perception of engineers and scientists." The calendar, which features the "young, single, sexy men" of Kennedy Space Center, is intended to verify that not all engineers are "pencil-necked geeks." What started as a fund-raising project turned into a booming business, with over 5,000 copies on order before the calendar was even printed. As one calendar model said, "People think we're all crew-cut squares, and we're out to change that."

Hubble Stuns Astronomers

At the January meeting of the American Astronomical Society in Atlanta, data from the Hubble Space Telescope continued to intrigue the astronomy world. Astronomers led by Jon Holtzman of the Lowell Observatory in Flagstaff, Arizona, reported discovering about 50 bright objects that appear to be young massive globular star clusters at the center of galaxy NGC 1275. Globular clusters are believed to be among the oldest objects in the universe, leading Holtzman and his team members to conclude tentatively that these new clusters may be the visible result of a merger or collision of two galaxies.

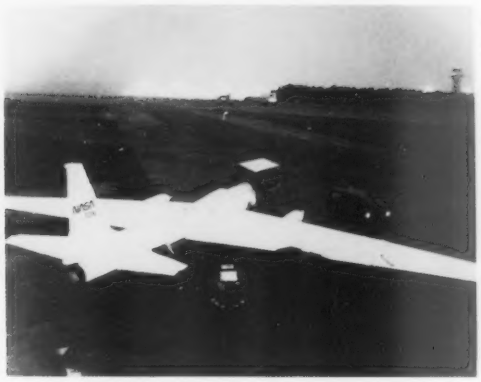
Another team from the National Optical Astronomy Observatories and the University of California reported finding evidence of a massive black hole at the center of the giant elliptical galaxy M87. The images, obtained by Hubble's Wide Field/Planetary Camera, show a densely concentrated cusp of light at the heart of the galaxy. The HST's resolving power revealed that the galaxy has a central density of stars more than 300 times denser than a normal elliptical galaxy. The estimated 100 billion stars of galaxy M87 are distributed toward the center as if drawn there and held captive by the gravitational field of a massive black hole.

The team emphasized that the Hubble images alone do not prove conclusively that the black hole is present, but that further examination of the galaxy using the orbiting telescope's spectroscopic instruments could confirm this.

Ozone Loss Confirmed: It's Deadly Real

Goddard Space Flight Center atmospheric scientists reported that data from the Upper Atmosphere Research Satellite have confirmed the link between the presence of chlorine monoxide and the depletion of ozone in the upper atmosphere. Previous measurements of this relationship were performed by NASA ER-2 aircraft flying over extremely limited regions. The UARS data are global.

At a press conference held at NASA Headquarters early this year, government and university scientists said studies of the atmo-



NASA ER-2 prepares for takeoff on Arctic ozone sampling mission.

sphere over Arctic regions and the northern hemisphere indicate that an Arctic ozone hole similar to the one already seen over Antarctica could develop easily. The team said their northern hemisphere readings showed the highest chlorine levels ever recorded in Earth's atmosphere. Furthermore, the measured level of atmospheric chlorine compounds could destroy as much as one to two percent of the Arctic ozone each day.

If This Is Jupiter, Turn South

On February 8, the European/American Ulysses spacecraft flew by the Solar System's largest planet at a distance of 280,000 miles. Ulysses observed Jupiter's giant magnetosphere from a vantage point never before seen by a spacecraft—high up near the planet's northern pole.

Ulysses also flew through a region between the orbits of the Jovian moons Europa and Io, which has been visited by only one other spacecraft, Voyager 1. The region contains sulfur and oxygen ions, which are being sputtered off the surface of Io and subsequently trapped into an orbiting cloud by Jupiter.

Ulysses departed the plane of the ecliptic on its way to chart unexplored regions of our Sun's poles, zooming by Jupiter at 61,000 miles per hour.

The Ulysses mission is a joint NASA-European Space Agency project.

JPL and Shuttle Radar Help Discover Lost City of Ubar

Using Jet Propulsion Laboratory computers and Shuttle Imaging Radar data, a team of scientists and archaeologists announced in February the discovery of a lost city on the edge of the "Empty Quarter" in the deserts of southern Oman, about 100 miles north of the Arabian Sea. The team, which included JPL Assistant Laboratory Director Charles Elachi and JPL research geologists Ronald Blom and Robert Crippen, believe they have found the fabled Lost City of Ubar.

References in the Koran and maps made by an Egyptian geographer in the second century mention such a city as the source of frankincense. The references cite a "many-towered city," which matches the octagonal, eight-towered ruin found by the modern archaeologists in their ongoing desert dig.

Shuttle radar imagery and subsequent computer enhancements made ancient camel tracks in the desert visible beneath the dry sand. By following a convergence of tracks in the images, the team was able to isolate the area where the ruins eventually were unearthed. Atomic dating techniques applied to some of the items at the site indicate an age of nearly 4,000 years.

American Technology Gets A Boost

NASA Administrator Richard Truly, Energy Secretary James Watkins and acting Secretaries of Commerce and Transportation Rockwell Schnabel and James Busey joined with industry and academia on February 12 to kick off the "National Technology Initiative" at a conference in Cambridge, Massachusetts.

The conference at the Massachusetts Institute of Technology was the first in a series of regional meetings designed to spur American economic competitiveness by promoting a closer working relationship between government, industry and the university community.

From Africa to Space

As part of NASA's observance of Black History Month, three noted African-American sociologists gave televised lectures from the NASA Headquarters auditorium during the month of February. The first presentation was on "African Roots Explore New Worlds: Pre-Columbus to the Space

Age" by Rutgers and Princeton University professor Ivan Sertima. The second lecture, "African Roots: 21st Century Revival," was given by lawyer and human resources consultant Dorothy Nelms. The final talk featured Nelson Onyenwoke, Director of the Albany State College Center for the Study of the Black Male, who spoke on "African Culture and the People of African Descent."

Public Service Recognition Week

On May 4-10, Public Service Recognition Week will be celebrated in cities throughout the United States. It is a week set aside to pay tribute to the profession of public service and to the "Unsung Heroes and Heroines" who make up the public work force. The week is sponsored by Public Employees Round-table and the President's Council on Management Improvement. NASA headquarters will have an exhibit on Washington, D.C.'s national Mall—the focal point of the week's activities in this area.•

TRANSITION

Died

Les Reinertson, 47, editor of *NASA Magazine*, died suddenly on December 17 while recovering from the flu. Reinertson joined NASA in 1981 as a public information specialist at the Dryden Flight Research Facility. While there, he won several awards for his work publicizing the first Space Shuttle flights. In 1987 he came to Headquarters, where he took over as editor of *NASA Activities*, which developed into *NASA Magazine* last year. Before coming to NASA, Reinertson served in the U.S. Air Force from 1967 to 1972, and he worked in private industry until 1980. He is survived by a wife and two sons.

Nominated

Following the resignation of Admiral Richard H. Truly, which was effective on April 1, **Daniel S. Goldin**, Vice President and General Manager of TRW Space and Technology Group,

Daniel S. Goldin

has been named the new NASA Administrator. Mr. Goldin began his professional career as a research scientist for NASA Lewis Research Center.

Returned to the Fleet

After nearly three-quarters of a year, technicians at Rockwell Space Division's Palmdale, California plant, have completed upgrading and maintenance activities for America's first operational **Space Shuttle orbiter—OV-102, Columbia**. This was the first major overhaul of Columbia since its first flight in 1981, nearly ten years before. Columbia's next mission is set for this summer, when it is scheduled to fly the U.S. Microgravity Laboratory-1 payload on STS-50.

Died

Former NASA Administrator **James Fletcher** died of cancer at age 72 on December 22. Fletcher had served two terms as head of NASA, first from 1971 to 1977, and again following the Challenger accident from May 1986 through April 1989. Fletcher led NASA for nine of the agency's 34 years—longer than any other administrator. He held a doctorate in physics from CalTech and also had served as president of the University of Utah.•

It's official—International Space Year is in full swing, with events scheduled from Germany to Brazil.

President Bush, Vice President Quayle and Admiral Truly kicked off International Space Year at the White House on January 24.

We Have Kickoff!

by Danelle K. Simonelli

International Space Year 1992 is now well underway, involving hundreds of scientific, educational and public activities worldwide. Here is just a small sampling of recent ISY events and coming attractions:

ISY Inaugural Events: President Bush, Vice President Quayle and NASA Administrator Richard Truly kicked off ISY in the United States during White House ceremonies held January 24. Government ministers and space agency heads gathered for similar ISY inaugural activities in Paris and Tokyo.

Space Science: The first new space mission of 1992—one that well exemplifies the ISY themes of global cooperation and scientific inquiry—reached orbit in January with the successful launch of the International Microgravity Laboratory (IML-1) onboard Space Shuttle Discovery. In February, U.S.-European cooperation was the cornerstone of the Ulysses spacecraft's encounter with Jupiter. Meanwhile, the International Halley Watch Archive, an unprecedented global collection of space science data on CD-ROM disks, began worldwide distribution in connection with ISY.

Conferences: NASA's Jet Propulsion Laboratory played host February 10-13 to the ISY Conference on Earth and Space Science Information Systems (ESSIS). The European ISY Conference, which focused on the use of space technologies to study planet Earth, was held in Munich, Germany from March 30 through April 4. The next major ISY meeting will be the World Forest Watch Conference in Brazil in May.

Exhibits: Two traveling museum exhibits opened recently in celebration of ISY. "Blueprint for Space," now showing at the IBM Gallery of Science and Art in New York City, traces the transformation of science fiction into science fact. "Star Trek: Federation Science," at the Oregon Museum of Science and Industry, uses Star Trek themes to explore basic scientific concepts. Coming up in June will be the premiere of "The Home Planet" exhibition at United Nations headquarters in New York.

Educational Activities: In January, the Young Astronaut Council distributed ISY curriculum materials to every elementary and junior high school in the United States and—in cooperation with NASA—launched an ISY children's poster contest.

The Planetary Society announced the winners of its "Together to Mars" essay contest in February, the same month that schools throughout Tennessee celebrated Tennessee Space Week, and the Rocket Research Institute headquartered in Glendale, CA, inaugurated its ISY student rocket launchings.

In March, West Chester University's Satellites and Education Conference helped teachers explore the use of satellite data in the classroom, and the National Science Teachers Association conference in Boston included special sessions dedicated to ISY. Numerous additional ISY educational activities will take place in the coming months, from NASA's Space Life Sciences Training Program to the Challenger Center's "Marsville" student simulation exercises scheduled to occur at Challenger Center locations nationwide.

Public Events: ISY 1992 opened in traditional fashion on New Year's Day in Pasadena, California, with two commemorative floats in the Tournament of Roses Parade. Also in January, the United Nations inaugurated its program to assist citizens worldwide in observing orbiting spacecraft from the ground.

April brings us Mission to Planet Earth Day, in which traditional Earth Day observances are being supplemented by space-oriented activities.

Stay tuned. •

Danelle Simonelli is Information Director for the U.S. International Space Year Association.

For more information on these and other ISY projects, contact the U.S. International Space Year Association at (202) 863-1734.

Sometimes you need a program to follow all the players in the annual deliberations over the fate of the space program. Here's our attempt to make order out of chaos.

Who's Who in Space Policy

by John Lawrence,
Office of Legislative Affairs,
NASA Hq.

Social scientists often like to adopt precepts developed in the laboratory for their own use. One that seems ripe for such adaptation is "chaos." In physical science, chaos is characterized by non-linear (unpredictable) results that occur when a great many variables influence a phenomenon. With the caveat that any list is sure to be incomplete, here are some of the "players" who often make space policy appear to be a chaotic enterprise.

The Administration

The *National Space Council* is the administration's senior policy-making body on space issues. Chaired by the Vice President, its membership consists of the heads of the various government agencies concerned with space policy, including the NASA Administrator. The *Office of Science and Technology Policy* develops general, broad-based goals and strategy and fashions them into a comprehensive framework. The Director of OSTP also is the Assistant to the President for Science and Technology. The *Office of Management and Budget* works closely with NASA in developing the agency's segment of the President's budget request, which is balanced against other functions of the government.

Executive Departments/Agencies

The *Department of Defense* has two advantages over NASA: a bigger space budget, and the ability to invoke "national security" as an instrument of persuasion. DOD's Cabinet-level status assures commensurate influence over two programs it conducts jointly with NASA—the National Aero-Space Plane and the National Launch System.

The *Department of Transportation* has regulatory control over the commercial launch industry through its licensing authority, while the *Department of Commerce's* new Office of Space Commerce is acquiring influence over remote sensing (Landsat), technology transfer, and trade agreements on joint space ventures. The *Department of State* is involved in projects such as Space Station Freedom that have international participation.

Committees in both houses have direct oversight jurisdiction (appropriations, authorization, and budget) over NASA, and there are similar committees for all the agencies mentioned above. It is impossible to overstate the importance of "jurisdiction" in the minds of committee members and staff, or the impact these committees have on budget and policy. NASA also is influenced by committees on Government Operations, Technology and Competitiveness, and Investigations and Oversight, as well as by the "arms" of Congress—the *Congressional Budget Office, Office of Technology Assessment, Congressional Research Service* and *General Accounting Office.*

And Many, Many More

State and local governments have their say in issues pertaining to NASA field centers and contractor plants, while courts hear requests by activists to halt launch operations. Meanwhile, various boards, committees and commissions—like the Aerospace Safety Advisory Panel and the NASA Advisory Council—wield their own influence. Moreover, these elements are targeted by countless private companies, interest groups, activists, academic institutions, financial organizations and various other entities seeking to shape opinion and policy.

We live in a pluralistic society, organized and governed in a way that assures that every voice is heard. Our current policy-making machinery definitely has that effect, acting as a safeguard to ensure that no single element, no special interest, has undue or unfair influence. The result is a balance that serves the greater good—the general welfare—rather than the vested interests of a few.

The suitability of chaos theory as applied to space policy has become even more satisfying recently. Scientists have discovered lately that non-linear phenomena frequently and surprisingly fall into patterns of symmetry and order, challenging existing theories of universal turmoil. In other words, what we call chaos only *appears* to be confusion and disarray because of our limited ability to understand.

Which means that the Government, like the universe, really does operate according to plan. •

For Shuttle inspector Blake Palmer, there are more volunteer projects than there are hours in the day. Somehow, though, he always manages to lend a helping hand.

Blake-of-all-Trades

by Sonja Alexander, Hq.

Dedication \ded-e-ka-shen\ n. 1: Blake Palmer.

You may not be able to find that definition in your own unabridged dictionary, but that's only because the folks at Webster have never met Blake Palmer.

Helping other people is second nature to Palmer, who has been a devoted volunteer for a wide variety of causes for more than 20 years. As a quality inspector of Shuttle payloads at the Kennedy Space Center, it would seem that his work schedule wouldn't allow him much free time. But when asked how he manages to juggle his hectic professional schedule with so many hours of volunteer work, Palmer's answer is simple: "dedication."

"I've always wanted to help others, and in this way I can accomplish one of my goals in life," says Palmer, who attributes some of his desire for volunteering to the fact that he himself was in a wheelchair for a short period after the Vietnam War. His temporary disability made him more aware of people who, unlike himself, had lifetime handicaps.

Palmer, who has lived in Orlando for over forty years, spends volunteer hours restoring homes for the needy or helping the severely handicapped at the Special Olympics. Whether the person in need is nearby or far away, it doesn't much matter to him. "There are some projects that have taken me 75 miles from my home," he says.

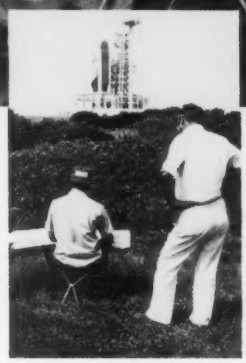
It wouldn't be unusual for Palmer to be up and out the door before 6:00 on a Saturday morning to work on a building project on the other side of town, or to finish his day around 7:00 that evening—stopping just long enough to take a quick lunch break. Besides restoration projects, this jack-of-all-trades has volunteered for the Muscular Dystrophy Association by accepting telephone pledges during their Labor Day telethon, and has volunteered with such organizations as the Children's Wish Foundation and the Red Cross. He has assisted handicapped children in learning how to use a computer. Through the Florida Council on Aging, Palmer has spent many hours helping out with the Meals on Wheels program. He doesn't specialize, nor single out any particular group to help; he says he enjoys working with all those in need, regardless of their age or handicap.

Many of Palmer's awards and recognition as a volunteer have come from his work with the Non-Commissioned Officers Association (NCOA), where he has been vice chairman and a member of the executive board for three years. Even though he is sometimes on the administrative side of volunteering, Palmer still likes to get personally involved. In his "spare time," he operates a computer network he developed called, "Up East," which caters to the general public, providing local bulletin board-type information to the nearby community.

After two decades of volunteering you might think Palmer would be ready to retire, but he says there are still more volunteer projects than there are available hours in the day. For him, he says, it's not a matter of choice: "I would feel a void in my life if I didn't give some of my time to fellow human beings in need." •

STS-6 artist Paul Arlt develops a watercolor study the day before Space Shuttle Challenger's first flight, April 4, 1983.

STS-8 artist Arthur Shilstone studies the interior of the Vehicle Assembly Building, while working on a watercolor in 1983.



Artist Mark McMahon drawing the Space Shuttle Columbia before its fourth flight in 1982.

"Spacelab 1," oil, 52" x 72", by Charles Schmidt.

Charles Schmidt works on a watercolor of the Space Shuttle Columbia.

Arts and Sciences

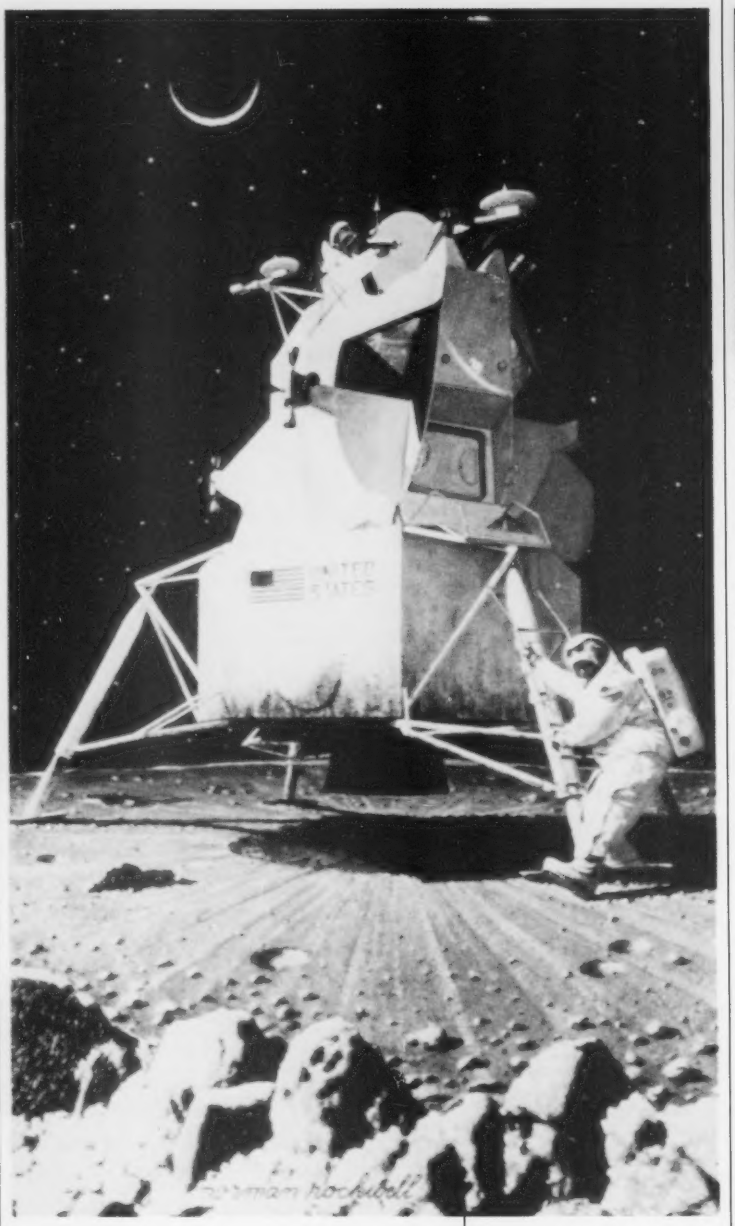
NASA's Art Program Captures What the Camera Can't

by Beth Schmid

September 29, 1988: With the Earth-shaking power of seven-and-a-half million pounds of thrust, Space Shuttle Discovery and America roared back into the manned space flight business. Cameras in hand, thousands lined the highways in the vicinity of the Kennedy Space Center to capture this moment in the history of our nation's space program. Amidst the spellbound spectators, neighbors, space buffs, vacationers, journalists and photographers, was a unique group of eyewitnesses: six artists and a musician commissioned by NASA to document their artistic impressions of the STS-26 "Return to Flight."

The NASA Art Program began in 1962 as the inspiration of then-Administrator James Webb, who believed that "important events can be interpreted by artists to give a unique insight into significant aspects of our history-making advance into space." Thirty years later, the program is still going strong. Since the first group of artists was dispatched to cover the final Mercury flight in 1963, over 150 painters and illustrators have participated in the program,including such famous names as Norman Rockwell, Jamie Wyeth and Robert Rauschenberg.

The art program thrived through the Gemini and Apollo years, but lapsed after



the last of the Moon shots. In 1976 Bob Schulman came to the NASA Public Services Division as the new graphics director, and immediately was handed the task of revitalizing the program for the approaching Space Shuttle era. He began by developing a group of artists—either those who had contacted NASA or those whom Schulman sought out himself. To this day, the program operates much the same way. If artists

Above: "Astronauts on the Moon," oil, 71-1/2" x 46-1/2", by Norman Rockwell.

Musician on commission: Saxophonist Jane Ira Bloom was the program's first—and so far only—non-visual artist.

Below: "Return to Flight," acrylic, 24" x 48", by John Solie.

accept the invitation to participate, they are awarded an honorarium with the understanding that the agency can keep one piece of art created by each artist. In this way, the NASA archive has continued to grow.

With Discovery's STS-26 mission, Schulman introduced a new medium—musical composition—to what had been an all-visual art program. Composed by New York musician and performer Jane Ira Bloom, "Rediscovery" reflected the magic, melody and mega-science of space flight.

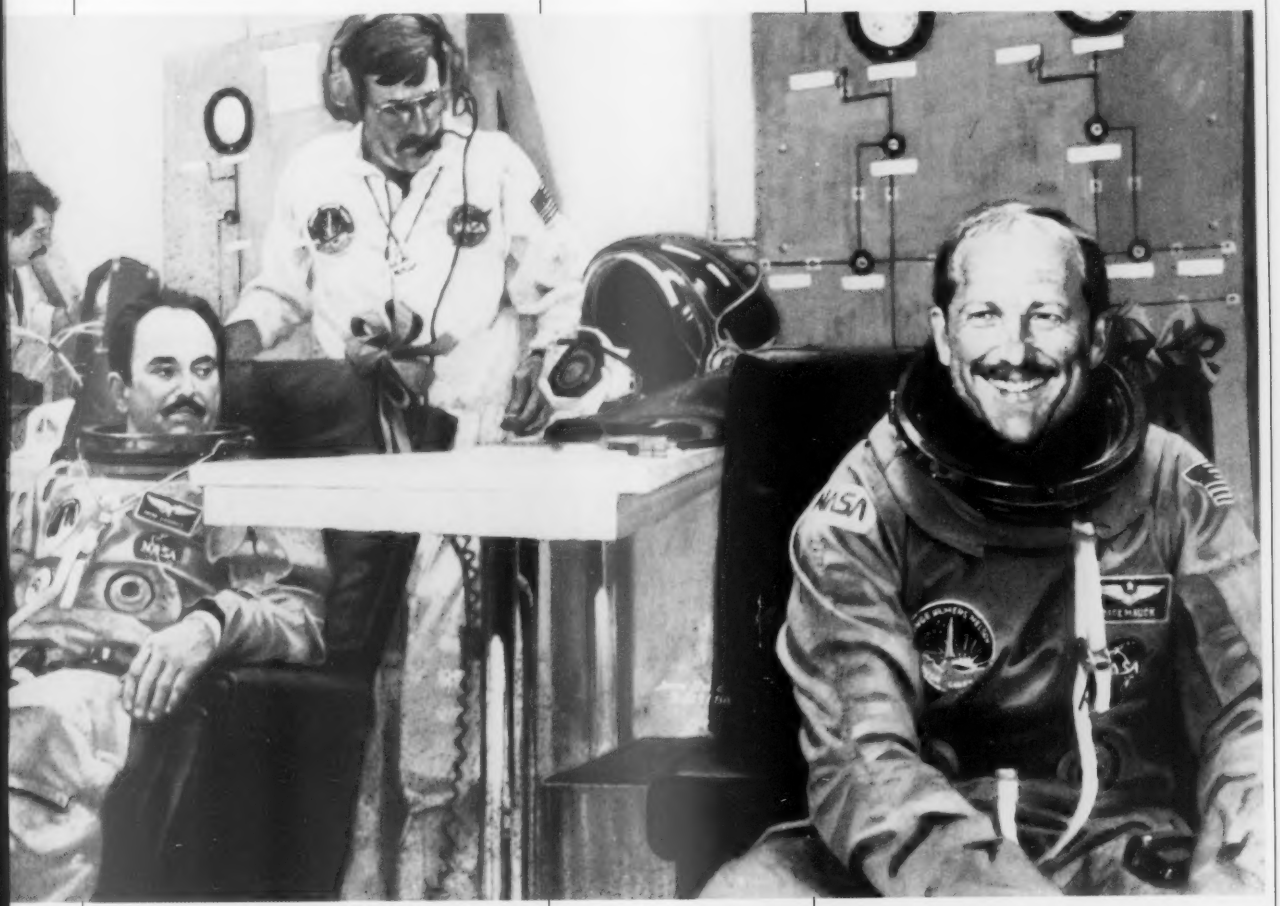
"I was honored to join the NASA art team covering the 'return to flight' launch," said Bloom. "I'd always felt that music could contribute to the documentary art program through its unique ability to convey something about the emotional side of the space program." By adding the work of a musician to that of visual artists, Schulman said, the

The artists have their own techniques for remembering the event. Some take photographs; some do sketches; and some just sit back, relax and enjoy.

STS-26 launch marked "another new beginning."

John Solie, one of the artists commissioned along with Bloom to document that flight, said of his experience: "After an almost three-year delay [after Challenger], the launch and the excitement of the NASA people around me when the second stage kicked in brought tears to my eyes." Another STS-26 artist, Michael Knigin, described the launch as the "most spiritual event" he had ever illustrated.

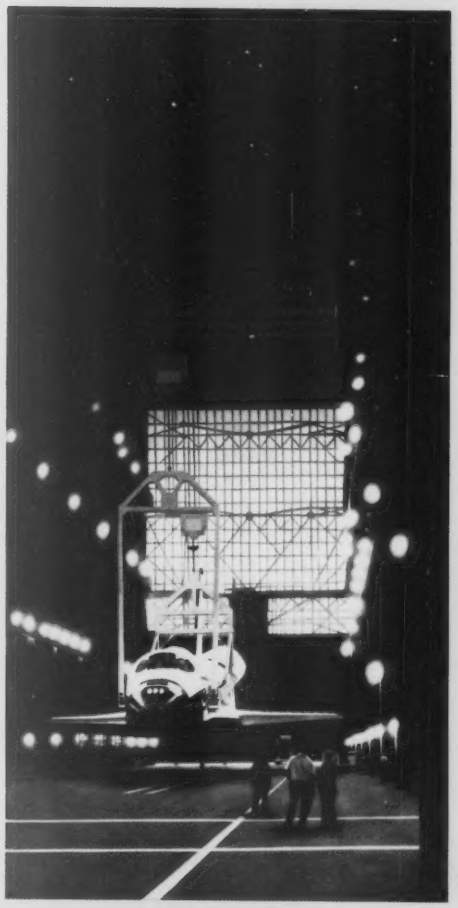
Angela Manno, who began painting space imagery in 1984, believes that artists and astronauts share a common thread: "Astronauts exploring outer space give us a better understanding of our world, while the artists painting them explore and portray their inner world, thereby expanding our



"Bringing in Big Boy," acrylic, 36" x 48", by Pamela Lee.

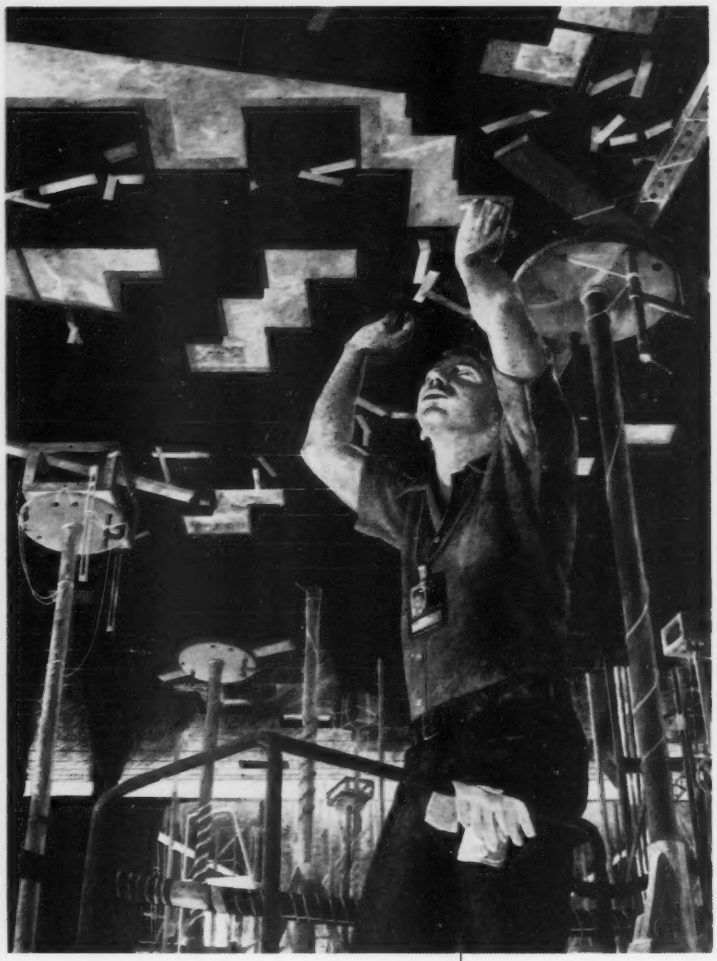
"Los Que Oien" (The Listeners), acrylic, 24" x 48", by Alan Chinchar.

"Star Kachina Spirit and Orbiter," acrylic, 50" x 40", by Dan Namingha.



"Cathedral," acrylic, 48" x 24", by Sam Ward.

"Woody Driver - Black Birdman," acrylic, 36" x 29", by Roy LaGrone.



"The Labyrinth," gouache, 52" x 40", by Charles Schmidt.

perceptions of the experience."

NASA sends artists to cover not only Shuttle launches, but other events unique to the agency's work. Schulman generally briefs each group of artists on the significance of the event they're covering, and personally shepherds them through the world of NASA. Artists have watched astronauts suiting up for space flights at the Kennedy Space Center and have been inside Mission Control as astronauts landed on the Moon. NASA has allowed artists to pilot Lunar Module simulators and to be onboard recovery ships when astronauts returned to Earth.

Because the agency gives artists free rein to paint whatever they want, however they want, the NASA collection includes images on paper, masonite and wood, as well as pencil sketches, collages, watercolors and oil paintings. Stylistically, the work varies from photo-realism to abstract. Most impressionists rely on instinct, spontaneity and the inspiration of the moment. Others have portrayed the space program with whimsy and an almost cartoon-like flair.

The background of the artists is just as varied. Charles Schmidt was a White House calligrapher during the Kennedy years, while Bill Robles was a courtroom illustrator covering the Charles Manson trial during the 1960's. Wilson Hurley is best known for his Western landscapes. Then there was the "man with the faraway eyes," as artist James Cunningham once was called. Cunningham, who was selected for his first NASA assignment in 1975, died tragically in a helicopter crash last summer. Cunningham's hard-edged abstract paintings combined the physical and the metaphysical, creating imagery that equalled his soaring imagination. Last July, he had visited the Ames Research Center's Virtual Reality Laboratory, where he experienced the illusion of flying across the face of Mars. Sadly, we will never know what paintings would have come from that trip. At Cunningham's memorial service, Bob Schulman spoke about his significant contribution to the space program: "Future generations will see historic missions through his eyes. That's a sliver of immortality."

Along with their individual approaches to painting "high-tech" subjects, the artists also have their own techniques for remembering the event. Some take photographs; some do sketches; and some just sit back, relax and enjoy. All of the above is A-OK with Schulman—as long as he receives a painting within six months of the event. Along with Shuttle flights, NASA artists have been commissioned by Schulman to portray space science missions, test flights of experimental aircraft, and tracking and data transmission systems. "Visions of Flight," a selection of NASA art works documenting all aspects of the space program, recently

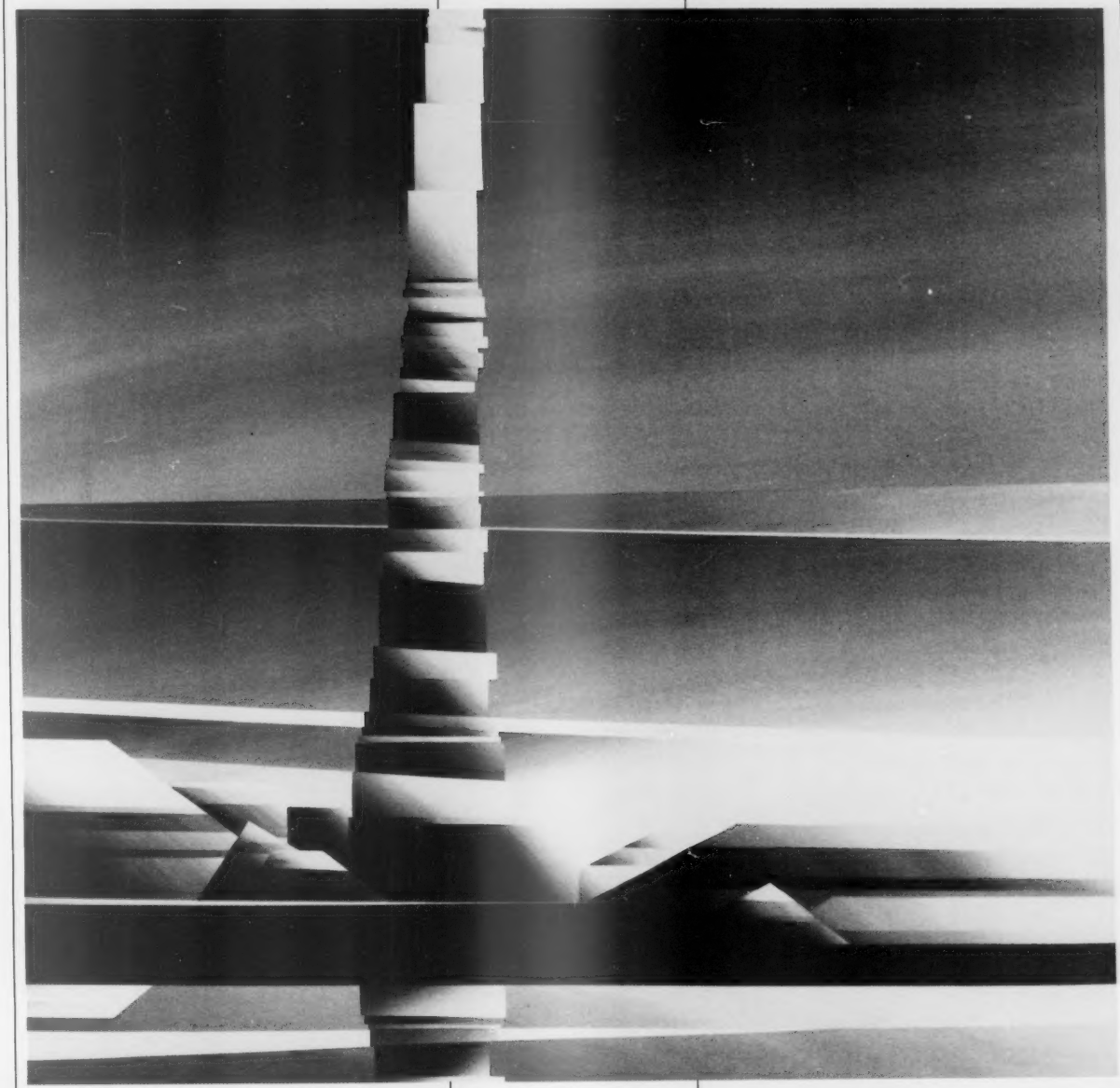
returned from a nationwide tour sponsored by the Smithsonian's Traveling Exhibit program. Another Shuttle-specific art exhibit is on permanent display at the Kennedy Space Center.

H. Lester Cooke, former curator of painting at the National Gallery of Art, has said of the NASA art collection: "In the long run the truth seen by an artist is more meaningful than any other type of record....Future generations will realize that we have not only the scientists and engineers capable of shaping the destiny of our age but artists worthy to keep them company."

Bob Schulman heartily agrees.

If you'd like to know more about how the NASA Art Program could support your next viewgraph presentation or speech, write to Robert Schulman, Director, NASA Art Program, Code POS, National Aeronautics and Space Administration, Washington, DC 20546.

Beth Schmid is Editor of NASA Magazine.



"Florida Coast - Fire Pillar," acrylic, 24-1/2" x 24-1/2", by James L. Cunningham, shows the artist's first impression of the Space Shuttle Columbia's column of exhaust.

To Russia With...

by Robert Schulman

A group of American artists gets a last snapshot of the former Soviet Union.

Artists, left to right: Alan Chinchar, Pamela Lee, John Solie and Andreas Nottebohm. Background photo is St. Basil's Cathedral in Moscow.

Friday, September 27, 1991

Dasfidáhniya ("Good-bye"). This was my much-practiced farewell to my family, who had been subjected to weeks of listening to Russian language tapes, along with my attempts at proper pronunciation. Together with a group of American artists, I was finally on my way to Moscow, to pay a visit to our counterparts in what was then still the Soviet Union.

The trip was part of an exchange whereby each nation's artists will produce paintings representative of the other country's space program. In return for our trip, NASA will host a Soviet art team to view a Space Shuttle launch and visit the Alabama Space and Rocket Center in Huntsville, Alabama. Paintings resulting from this first government-endorsed U.S.-Soviet artists' exchange are to be highlighted in an exhibit that eventually will tour both countries.

At New York's Kennedy Airport, I met the four artists whom NASA had commissioned for the job: Alan Chinchar of Houston, Texas; Pamela Lee and Andreas Nottebohm, both from California; and John Solie of Seal Rock, Oregon. All four are currently represented in the NASA Space Art collection, and all had worked with me before. Although we'd been planning this trip for some time, it was only after we were airborne that the excitement and anticipation hit home. It was hard to believe we really were on our way!

Saturday, September 28: Day 1

Zdráhstvooytye...dóbrai óotra ("Hello, good morning"). After going through customs at Moscow's Vnukovo Airport, we located our Soviet hosts and greeted them in Russian. They just smiled, and we traded warm handshakes and embraces. Artists Victor Dubrovin, Peter Kovalev and Olga Kovaleva were joined by Vitaly Myagkov, Secretary of the Union of Soviet Artists, which organization was sponsoring our visit.

Myagkov informed us that he would meet us early the next morning at a military airport to fly to Baikonur, the Soviet spaceport in Kazakhstan, where we would view a launch of a crew to the Mir space station. With the Soviet artists, we then boarded a bus for Senyesh, the Union's retreat located on the edge of a lake, about an hour's drive from Moscow. Although the amenities were not deluxe, our hosts treated us with traditional Russian hospitality, and prepared a table of food and refreshments. It was a warm, intimate and friendly evening. Although we didn't have the expected services of a translator, the son of one of the artists helped with both Russian and English, and we just about got by.

Sunday, September 29: Day 2

Sicháhs pyat'chasóf óotrom ee idyót doshch ("It's five o'clock in the morning, and it's raining"). Up early for the trip to Baikonur. By 8:30 a.m., our group and a large gathering of journalists had boarded a military transport for the four-hour flight to the ancient Kazakh steppe, which had been brought into the 20th century by space technology. The flight was a little like riding in a rain barrel, and the landing couldn't have come soon enough.

A bus took us to the city of Leninsk and to our hotel located on the edge of the town square. Approximately 100,000 people—mostly young families with many children—live in Leninsk. Most work at the cosmodrome, and they take great pride in the accomplishments of their space program. At the far end of the square, a very large statue of Lenin with his arm outstretched seemed to be welcoming us. We all waved back.

Tuesday, October 1: Day 4

Fchom dyéla ("What's going on?") Breakfasting at the one and only restaurant in town, where raucous rock n' roll music blared non-stop, that was the question on all our minds. We still hadn't seen an itinerary in English, and were somewhat in the dark. Myagkov soon arrived, however, and took us to meet General Alexei Leonov, the famed cosmonaut, first man to walk in space, and an accomplished artist himself.

Leonov greeted us warmly and took us for a brief walking tour of the "Avenue of Heroes," a garden area with trees planted in honor of Russian and American spacemen. After he excused himself—he was in charge of the crew about to leave for Mir, and had much to do—we visited the assembly building and test hangar for Energia, the powerful Soviet rocket. We felt as though we were inside NASA's Vehicle Assembly Building. Even though this place wasn't as high, it was cavernous, and very high-tech—a real contrast to some of the deteriorating architecture we'd been seeing during our trip. The Russians put real effort into these space facilities, and they get the job done.

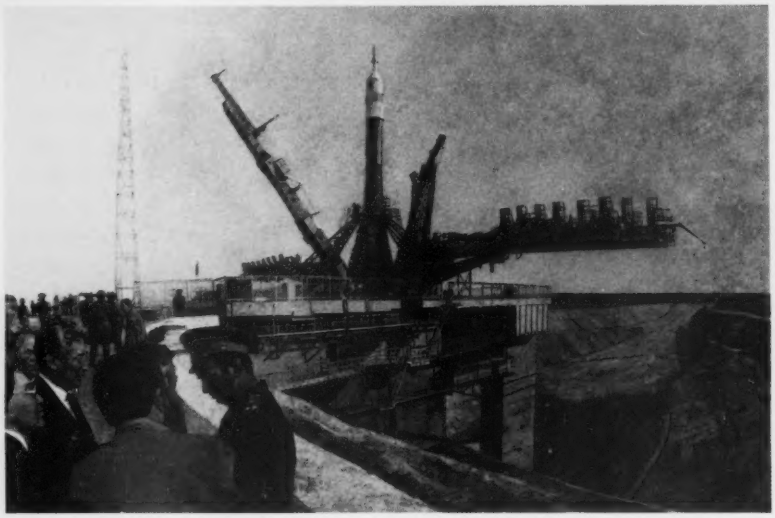
After being duly impressed by Buran shuttles in their hangars, Proton rocket carriers and other space vehicles in this mammoth facility, we headed back to Leninsk and our hotel on the square. As we left the bus, out of habit, we waved back at the statue of Lenin. Tomorrow was launch day, and the weather promised blue skies and sunshine.

Wednesday, October 2: Day 5

Sridáh—prikráhsnaya pagóda ("Wednesday—the weather's fine"). After a sleepless night and another breakfast with our ever-present rock n' roll music, we boarded the bus and headed for the launch site and a 9:30 a.m. lift-off.

Our first stop was to view the walkout of the crew, which included a brief ceremony in front of stands filled with spectators and dignitaries, including Nursultan Nazarbayev, the President of Kazakhstan, who had a stake in this launch of the first Kazakh cosmonaut, Tokhtar Aubakirov. The crew finally emerged from a building, waving and smiling at the audience. After a short ceremony and photo opportunity, they turned and headed for the van that would take them to the launch pad, which they boarded with another wave to the crowd.

We all then surged toward our buses, which carried us to the viewing area. The countdown (in Russian, of course) went smoothly, with few holds. Suddenly there was ignition, smoke and a gleaming phosphorus blast of light at the base of the rocket. Before you could say, "I hope it goes," the rocket was rising with fantastic speed, right on schedule. We all scrambled to get a better view. Outside our pavilion, we were able to spot the fiery light before it disappeared from sight. Translation of the Russian Mission Control voice



Artist John Solie's 36" x 54" acrylic painting depicts the "Last Launch of the Soviet Union," with President of Kazakhstan, Nursultan Nazarbayev, in foreground.

confirmed a successful launch. The three cosmonauts were on their way to Mir.

The crowds then milled about, shaking hands and congratulating one another. The atmosphere became very festive, with Kazakhs and Russians selling food, jewelry and souvenirs at stands packed with buyers. Three large, decorated tents shaped like domes provided the backdrop, while a pair of camels tethered to small radar structures added a touch of incongruity. Accompanied by Kazakh music played on native instruments, three women in lovely native dress performed a graceful dance ceremony in honor of President Nazarbayev and his entourage, while aromatic wisps of Shashlik (Shish kebab) floated in the air.

We hated to leave, but since we had to fly out of Baikonur early that evening, we called it a day. After a smooth flight and perfect landing, we emerged into the cold and rainy Moscow night to gather our luggage, which sat in puddles of water on the ground. Fatigued, soaked and hungry, we took a bus back to Senyesh for a much needed rest.

Friday, October 4: Day 7

Skol'ka éta stóit? ("How much is this?") Back in Moscow we must have asked this question a hundred times, and it finally paid off with some interesting gifts and souvenirs. We shopped at the Arbat, an artsy-craftsy, outdoor pedestrian mall that Muscovites like to call their Greenwich Village. As we went from shop to shop, we were approached by nervous-looking black market dealers carrying bags filled with numerous items to sell, which we avoided.

We also visited a number of historic areas, including the Lenin Library, the monument to Pushkin and the Bolshoi Theater, which we had hoped to attend. Finally, we headed for Red Square and the Kremlin just in time to witness the changing of the guard. It was worth every photo we took.

Moscow is a city of contrasts and paradoxes. Although they are surrounded by culture, the people seem to move about with a rather glum and somber disposition. The Soviet Union we saw was a place of confusion, even for those in "authority." Every time a questionable situation arose, the answer was always "no problem." Unfortunately, the problem never disappeared.

With the sun lowering on the horizon and evening approaching, we went to dinner—our going-away banquet—at the restaurant in the Union of Artists' building in Moscow. We lifted our glasses to our Russian friends: *Zavahshi Zdarovyi* ("To your health"). There must have been at least 20 toasts in honor of our last evening in Russia. After dinner we bused to the Russian Gypsy Theater, where we were treated to the melodic strains of Gypsy music, song and dance, the end of a truly perfect and enjoyable day.

Saturday, October 5: Day 8

Spasíba zafsyó ("Thanks for everything"). With these parting words and a lot of handshakes, tears and warm embraces, we left our Russian hosts and headed for Customs. So many things had happened that we were filled with mixed emotions. Some of us were feeling under the weather, and all of us were looking forward to sleep.

Before we turned the corner and disappeared from sight, all of us, as though of one mind, suddenly stopped and looked back to see our hosts standing there with their arms outstretched in farewell. Somehow, I kept thinking of that Lenin statue in the square. We raised our arms, and although they couldn't hear us, softly whispered in a sort of bittersweet way, *Dasfidahniya*, "Good-bye." •

Robert Schulman is the Director of the NASA Art Program at Headquarters.

What's a Space Artist?

"'Thanks' is a heck of an understatement for this whole adventure. NASA's program is all I ever want to paint anymore."

So wrote Houston artist Alan Chinchar after covering the STS-26 launch in 1988. Chinchar's work for NASA includes "One Small Step for a Man," depicting the Apollo 11 landing, and the painting on the cover of this issue, "Space Station Freedom: Keystone to Human Exploration." We asked him to comment on that painting and on how the space program influences his art.—Editor

In the aerospace industry, you call in an artist when the engineers have the concept frozen on a CADS printout and they want a way to stand back and look at the fully-assembled machine they've wrought. The artist becomes an intuitive camera, and thus pays his bills.

But there's more to it than that. Though I, too, am thoroughly fascinated with technology, the thing that keeps me excited about what I paint is what we're doing with these machines and where they're taking us. We are actually beginning our expansion into space, and seriously discussing a permanent presence on the Moon and Mars. We've opened a door that will never close.

Through my artwork, I try to communicate the amazement I feel at this milestone in the history of the human race, the beginning of the greatest adventure we've ever known. And through my artwork, I can contribute and participate. I tell the story.

After a few fairly basic "rendering" assignments related to Space Station *Freedom*, I was floored by a request to paint the Station as I see it, and to make a statement about it. For a long time I had been advocating a representation of the Station that said something other than, "Power management and distribution system palette goes here." I'd never believed that such a straight rendering told the taxpaying public anything about *Freedom* other than, "It looks like this." I'd long maintained that pictures that tell stories would communicate the ideas—the mission—behind the hardware. *That's* what we were asking support for, and I was willing to bet that few taxpayers actually cared what it looked like.

My bluff thus called, I then did what many a believer might do when unexpectedly handed the microphone. My mind went on a brief leave of absence. Gradually, though, I began to recollect some of the reasons I so strongly support the idea behind the Space Station, and to put them into a composition.

Naturally, people have read the resulting painting in different ways. Some see a progression of exploration, others a wish-list of NASA programs. Still others see it as a needless and frivolous attempt to glamorize an efficient array of alloys and composites.

To me, Space Station *Freedom* has always suggested a physical commitment to our permanent presence in space. I see *Freedom* as a genuine settlement at the edge of a frontier, destined to fill a role similar to the original colonies along our eastern seaboard or the forts along the old Santa Fe or Oregon Trails.

The debates around Space Station *Freedom* have fascinated me. On one hand I hear the arguments of those who see space as the next logical opportunity for this country to continue pioneering. These people are opposed by those who believe such an attitude has become a luxury that cannot in good conscience be budgeted until we've solved the lingering problems of the last six or eight thousand years.

There's a sense of deja-vu around these debates. I can almost hear the shrill echoes in the venerable old forum of Parliament. "Let us not concern ourselves with this Jamestown wilderness adventure until we've weaned our populace away from the evils of gin!" I can visualize a Senator intoning before his colleagues, "To what useful purpose, Mr. Chairman, would we put a fort with a regiment of cavalry in a worthless, utter wilderness on the banks of the Missouri river?"

Though their motivations may be noble, these arguments seem short-sighted and exclusionary. Exploration and discovery can yield options not currently available, and this makes them viable problem-solving tools. It's heartening for me to remember that the few people who create change always seem to surface through the layers of complacency, closed minds and narrow vision. As future Americans travel the new avenues of the next frontier, they'll celebrate those first few, never fully understanding how hard-won came the rewards.

But first there must come another Jamestown or Fort Bent. We have people willing to reach outward, take the risks and prepare new places for the nation to grow into. All they ask of those who stand and watch is the means. And judging from our consistent history, that's a small enough investment for the kind of return we can expect. • *—Alan Chinchar*

Wings t

In 2021 your plane may be able to take off after breakfast and get you to Japan by lunchtime, thanks to high-speed research now underway at NASA.

by Les Dorr, Jr.

When NASA Magazine debuted in 1991, large-scale supersonic air travel was still a dream. Thirty years later, a fleet of supersonic transports—most of them American-made—carries millions of passengers around the globe every year. Award-winning author and screenwriter Les Dorr, Jr., who wrote for the magazine's first issue as a Headquarters employee, agreed to share his impressions of one of these super-high-tech airliners: the Mach 2.4 UltraClipper.

March 17, 2021, San Francisco International Airport

"We sincerely apologize for the unexpected delay," the Japan Air Lines captain says again, with perhaps just a hint of frustration. "We expect clearance to taxi very shortly."

Ugh. We can build Moon bases and put people on Mars...so why does it still take 30 minutes to get off the ground at the airport?

I suppose I shouldn't gripe. Once it's in the air, the UltraClipper will make it to Tokyo in about four-and-a-half hours. Not to mention that I couldn't even have taken this trip just a few years ago. Until the Clipper entered service, supersonic air travel was only for the rich and famous. Now even an aging aerospace journalist can afford to zoom across the Pacific at almost two-and-a-half times the speed of sound!

Most of my 262 fellow passengers have their heads buried in their laptop supercomputers or are doing one last piece of business via the seat-back videodata terminals. It's a good bet they take for granted all the advanced technology that drives this 100-meter-long, needle-nosed beauty through the air.

They'd probably be surprised to learn how much NASA had to do with putting it there.

By the early 1990s the Pacific Rim countries had become economic powers, and trans-Pacific business travel had jumped dramatically.

American executives found that the 10-hour trip was no picnic, even in business class on the largest subsonic airliners. Throw in "jet lag" due to the time difference—Japan is 17 hours ahead of the West Coast—and it became clear that a truly global economy demanded a better way to get from here to there.

Many aviation experts of the 1990s predicted (correctly) that the first country to come up with a new high-speed civil transport would dominate the commercial supersonic market. But there were major technical hurdles to overcome before supersonic airliners would make practical business sense.

NASA had a history of developing aeronautics technology that U.S. industry had used to maintain its leadership in world aviation. To meet the supersonic transport challenge, NASA began a five-year effort called the High-Speed Research Program in 1990. It was aimed at solutions to the environmental concerns that could have barred full-scale commercial development of the aircraft: airport noise, exhaust emissions and sonic booms.

Consider the noise problem. The first supersonic transport, the Anglo-French Concorde, was a real ear-blaster. As it took off and climbed away from the airport, sound levels were as high as 120 decibels. (I know firsthand; it used to fly right over my old house in Maryland!) But today's supersonic airliners meet the same strict standards that apply to new subsonic passenger planes.

The UltraClipper adopted several noise-reducing technologies that NASA helped develop in the High-Speed Research Program. For example, NASA computer studies and hardware tests led to the "variable-cycle" power plants now used on these planes. During takeoff and climbout, the engines act like turbofans; noise is limited to a deep-throated hum. When the aircraft reach higher altitudes and accelerate through the sound barrier, the engines shift to turbojet-like operation for maximum performance.

NASA and industry also teamed up to devise the noise-suppressing exhaust nozzles found on today's supersonic airliners. Part of the effort focused on proving that the "mixer-ejector" design—a nozzle that quickly mixes low-energy outside air with high-energy engine exhaust—was the best bet to lower the decibel level. NASA also played a leading role in researching light-weight, high-temperature materials

that kept nozzle weights down, an important factor in making the engines more fuel-efficient.

There was genuine anxiety in the 1990s that a fleet of high-speed airliners releasing exhaust with significant amounts of nitrogen oxide ("NOx") into the stratosphere would cause unacceptable levels of ozone depletion. Most aviation analysts agree that NASA's High-Speed Research Program deserves much of the credit for overcoming that potential obstacle with a two-pronged approach: Define the extent of the problem and simultaneously work on a technological solution.

NASA spent millions during the '90s to investigate ozone depletion with satellites, aircraft, ground stations and computer models, including studies directly linked to supersonic transport emissions. As the data came streaming in, scientists plugged them into computers and calculated the potential effects of exhaust emissions by a supersonic airliner fleet. The results showed that there were areas in the lower stratosphere where the planes could operate and not deplete ozone. But there was a catch: NOx emissions had to be cut by 90 percent from the levels produced by '80s-technology engines.

Reducing NOx was the most difficult technical challenge in the High-Speed Research Program. The key turned out to be burning the jet fuel in a way that avoided excessive flame temperatures, an approach that slowed the rate of NOx production. NASA and industry ran thousands of hours of computer simulations and combustion tests to make sure various ratios of fuel and air would mix and burn properly. The result: confidence that low emissions, reasonable fuel economy and high performance could be combined in a single engine.

NASA and the major engine manufacturers also tackled a related problem. The traditional method of cooling the combustion chamber walls—with air—couldn't be used because it would have affected the reaction process. Researchers ultimately found the answer in new classes of durable ceramic composite materials that function uncooled at high temperatures for long periods of time without cracking or eroding.

In 2021, all U.S. supersonic passenger planes use some form of the NASA-developed low-NOx technology in their engines. Most important, continuing studies show that their exhaust emissions aren't a threat to the environment.

"Passengers, please prepare for departure," says the lead flight attendant's voice through the cabin speakers. "Seat restraints will close automatically in 30 seconds." At last! A gentle nudge from an airport tractor and we're moving backward away from the gate. As the plane is pushed around to the taxiway, I see out my window that the observation deck is jammed with people. The crowds are there every daylight hour just to watch the UltraClippers take off and land.

No wonder—the transports' long, slender bodies and gracefully curved wings make them the most visually striking aircraft in the sky. But in this case, form follows function. The planes are aerodynamically designed to minimize the "boom" that occurs when they fly faster than Mach 1, the speed of sound.

NASA engineers couldn't negate the physical laws that cause sonic booms, but they found they could bend them a little. With wind tunnel experiments and extensive computer modeling, researchers fine-tuned the shape of high-speed transport concepts to reduce boom noise reaching the ground. The predicted economic penalty was minor; a low-boom aircraft was only one to two percent more expensive to operate.

McDonnell Douglas' conceptual design of a Mach 3.2 supersonic transport would

As a result of NASA's work, overland supersonic flight through several sparsely populated corridors became practical, and the economics of high-speed passenger travel became even more favorable. The airliners have to throttle back to about Mach 1.6 through the corridors, but even the reduced speed

makes the planes more productive than they would be in subsonic operations.

The wings on these high-speed transports are full of holes—millions of them! The tiny laser-drilled openings are part of a nifty technology called "supersonic laminar flow control" that greatly boosts the planes' fuel efficiency. And—no surprise—it evolved from devices that NASA tested in its aeronautics program in the 1990s, more than 20 years ago.

be sized to carry approximately 300 passengers 7,500 statute miles.

A plane cruising at supersonic speed is very sensitive to "drag" caused by air friction on its skin. The greater the drag, the more fuel is needed to accelerate and maintain speed. One way to lower drag, however, is to suction off small amounts of the airflow very close to the wing's upper surface so that the air remains smooth, or "laminar," and doesn't become turbulent.

In the High-Speed Research Program, NASA put supersonic laminar flow control test sections on two F-16XL research aircraft. A suction pump removed surface air through microscopic holes in the test areas while the plane flew at speeds up to 1900 kilometers per hour. Eventually, the research achieved laminar flow over more than half the wing—results that encouraged aircraft manufacturers to design the technology into a high-speed transport from the start.

When the sun reflects off the wings, tail or fuselage of today's supersonic airliners, you'd swear they're made entirely of metal. But much of the airframe is really advanced polymer composite material—a more exotic version of the stuff now used in everything from lightweight tennis rackets to car bodies. There are no rivets, no skin-on-framework construction. Just smooth, integrated forms that are much lighter than the aluminum structures they replaced.

Aircraft companies realized the benefits of composites as long as 50 years ago. They weigh about half as much as metals and don't have the same corrosion and fatigue problems. Still, there were drawbacks: Large-scale composites were very expensive to make and not enough was known about their long-term durability.

In the 1990s, government, industry and universities joined forces to come up with advanced composite materials and manufacturing methods. NASA led the scientific research on composites and helped develop the automated processes that brought manufacturing costs down. Aerospace executives often acknowledge that the fuel and maintenance savings resulting from the "composites revolution" were keys to affordable supersonic passenger travel.

"We should be taking off momentarily," the captain announces. "There are three aircraft ahead of us." The videodata screens light up with a high-definition TV image from the forward cockpit camera. I can see the other planes: Clippers decked out in United, Qantas and Korean Air livery, respectively.

Those airliners represent the real product of NASA's aeronautics research. It's difficult to overstate how vital the aviation industry is to the nation's economic health and competitiveness. American aircraft firms employ hundreds of thousands of people, and their exports are the major positive factor in our trade balance. The bottom line is that four out of five supersonic transports in 2021 are American-made...and they might not be there if NASA hadn't paved the way.

Takeoff! The power of four 50,000-pound-thrust jet engines gently pushes me into my seat as we accelerate down the runway. The ground falls away as the Clipper points its nose into the sky. Next stop: Tokyo. Probably in time for lunch.

But I still refuse to eat sushi. •

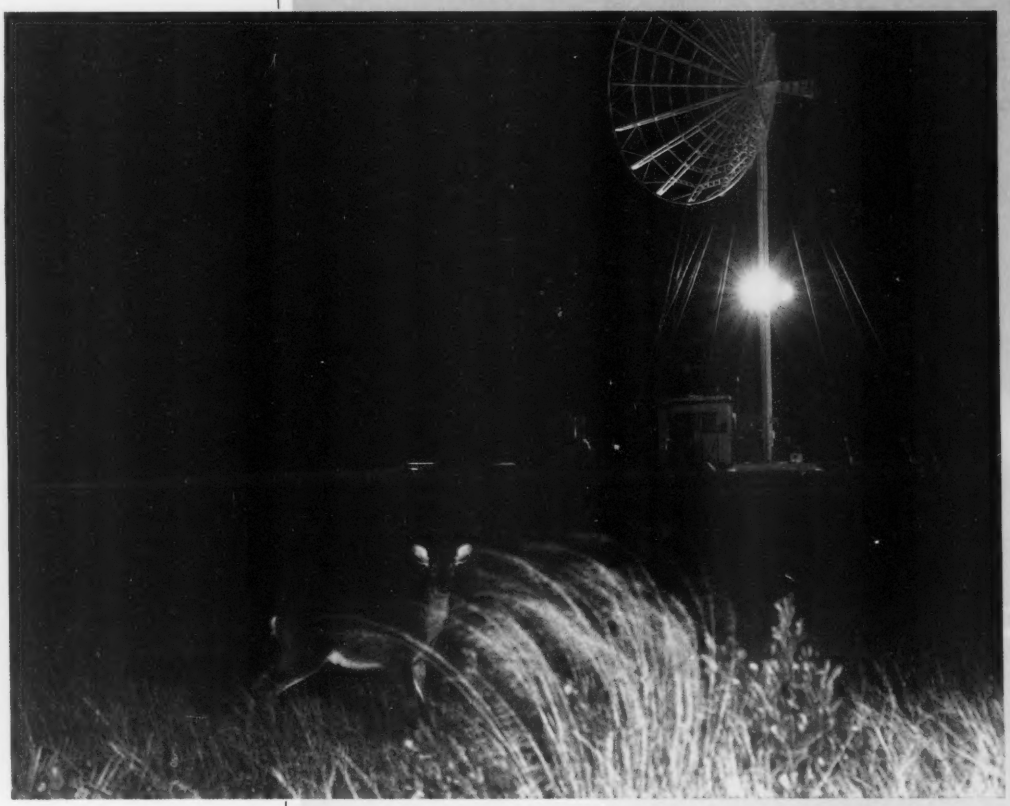
Les Dorr is a frequent contributor to NASA Magazine. *He works in the Headquarters Office of Aeronautics and Space Technology for the Office of Public Affairs.*

A Walk on the

In among the Kennedy Space Center's high-tech launch pads you'll find one of the last unspoiled wildlife refuges in the East.

Anyone who has ever walked along a seashore knows about the vast amount of debris that regularly washes up on our planet's beaches, as well as the condominiums, restaurants and assorted other man-made structures that have forever altered the shape and natural evolution of our beachfronts.

Too much of America's coastline fits the above description, but central Florida—and specifically NASA's Kennedy Space Center—represent one of the last strongholds where land, seashore and inland waters remain largely undisturbed by humanity. With Daytona Beach to the north, Cocoa Beach to the south and Disney World and metropolitan Orlando to the west, KSC is an unspoiled oasis in a rapidly changing Florida landscape.



More than 140,000 acres of land and 25 miles of near-pristine beachfront are contained on the property from which many of history's greatest extraterrestrial adventures have begun. The towering launch pads at Kennedy are only the most visible features on this flat expanse of land that also includes the Merritt Island National Wildlife Refuge and Canaveral National Seashore. Along with the Fish and Wildlife Service and the

Beach at KSC

by Mitch Varnes

"With tidal pools settling in the sands, pelicans, sandpipers and laughing gulls wading together in the surf, and rolling sand dunes blocking the almost other-worldly launch pads, my view must have rivaled that of the first Spanish mariners who came ashore here nearly 500 years ago."

National Park Service, NASA has helped to preserve this native Florida habitat, which has more endangered and threatened species than any other such place in the continental United States. As a result, visitors taking the bus tour around NASA's primary launch site are privy not only to the spectacle of high-tech engineering marvels, but also to the sight of alligators, armadillos, bald eagles, manatees and scores of other species that frequent the facility.

The Canaveral National Seashore opens its gates daily to visitors who enjoy its untainted beaches. During the summer, park rangers even lead excursions to nesting sites where thousands of rare and threatened sea turtles return each year to lay their eggs. As relatively untouched as these areas may be, however, they are still readily accessible and regularly visited. Traces of humanity aren't as conspicuous as they are at more public beaches, but they're still visible: discarded cans and wrappers, footprints, broken clamshells left behind by fishermen. If people have this much impact on a protected national seashore, what kind of effect, if any, have they had on the beaches that nobody visits?

It was with this thought in mind that I decided to wander the shores behind the two Space Shuttle launch pads—a place as secure and restricted as any outdoor area in the nation. With the consent of NASA security, I parked my car near Pad 39-A and headed a hundred yards or so east, toward the Atlantic Ocean.

From the moment I stepped off the road, I knew this shoreline was going to be

different. The ankle-scraping brush I was used to crossing at beachfronts was overgrown, replaced with waist-high sawgrass, sea oats and flowering cactus. I could hear the scurrying and slithering of rodents and snakes as I kicked the plants ahead of me before each step—a little alarming, maybe, but not unexpected. After all, this *is* a wildlife refuge.

The only break in the vegetation came from the railroad tracks that run along the easternmost boundary of KSC, where it adjoins the Cape Canaveral Air Force Station. The tracks were laid in the early days of the space program, but are still routinely used by NASA, the Air Force and their contractors for transporting supplies and launch-related equipment.

Once across the tracks, out of the brush and at the edge of the dunes, I was surprised by a shoreline that dropped some ten feet below. Clinging to shrubbery, I slid over the edge and onto the beach. Right away my question was at least partially answered. Up against the sand bank were half-buried bottles, shattered bits of plastic and styrofoam pieces—all washed ashore and blown to the dunes. Every few steps brought new discoveries: rotted shoes, sun-bleached combs, bits of tattered nylon rope, fishing bobbers and broken buoys. Cocktail straws, party streamers and busted balloons were the most common kinds of debris—souvenirs from the cruise ships that steam daily through the waters of nearby Port Canaveral. Even the most pristine and sheltered beachfronts, it seems, are vulnerable to the tides, winds and carelessness of humanity.

A bobcat—one of the native inhabitants around the KSC wildlife refuge—has its picture taken after stepping on a remote activated switch buried under the sand. The 35mm Nikon camera was set up outside the perimeter fence at launch pad 39B.

As disturbing as these sights were, they were surpassed by the innocence and unspoiled beauty of the beach beyond. Twenty yards wide, with unrestricted visibility to the north, south and east, the seashores of Kennedy Space Center are spectacular even in comparison to the neighboring public beaches at Canaveral National Seashore. With tidal pools settling in the sands, pelicans, sandpipers and laughing gulls wading together in the surf, and rolling sand dunes blocking the almost otherworldly launch pads, my view must have rivaled that of the first Spanish mariners who came ashore here nearly 500 years ago.

By the time the Europeans arrived, of course, the area had long been inhabited by the Ais, a now-extinct tribe who were the first residents of the land on and around Cape Canaveral. The Ais fished, hunted and thrived here for thousands of years before the arrival of the Spaniards, and they remained for at least another 250 years

afterward. Many native artifacts have been unearthed during construction activities at the Florida spaceport, and dozens of burial and midden mounds still rest undisturbed around the space center.

Cape Canaveral first appeared on a map—albeit greatly off-scale—in 1502, when it was depicted as a large bump protruding from a crudely shaped Florida peninsula. This notch was labeled Capo de Canaveral or "Cape of the Canes," for the savannas and canes that dominated the beach and inland areas. The waters east of the Cape soon became a main route for seafaring pirates and European cargo and passenger vessels. Ponce de Leon and an entourage of explorers from three accompanying ships are even reported to have searched for the legendary Fountain of Youth on the barrier island now owned by NASA.

Although there were initial and periodic conflicts between the Spaniards and the Ais, the two groups interacted so well that in 1763 they boarded the same vessels and sailed together to Cuba, which Spain had acquired from England in exchange for Florida. The flags of a few other nations flew over Florida before it joined the union in 1845, but none—including the Stars and Stripes—has ever interfered with the seasonal influx of northerners and Europeans to the Sunshine State.

One of KSC's 5,000 alligators suns himself near launch pad 39A.

Startled out of my reverie by the squawking of a pair of blue herons, I realized that I had already walked the two miles to Launch Pad 39-B. The beach ahead of me was as infinitely enticing as when I started, while the only news behind me was my footprints.

Squishing my toes in the sand, I realized how lucky America is to have chosen such a site for its spaceport. The spinoffs from our country's space program have been widely touted, but this unsung spinoff was an especially wonderful bonus. Were it not for the large scale of our space effort, Florida would most likely be one wall of development from Jacksonville to Miami. Sure, a little trash washes on our shores every once in a while, but they're not like those of Cocoa, Daytona or any other public beach.

And thanks to NASA, they never will be. •

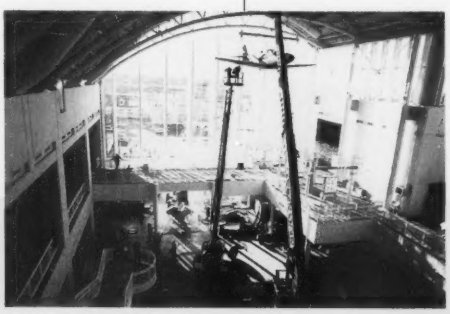
Mitch Varnes is a public affairs officer at the Kennedy Space Center. He is an avid outdoor and water sports enthusiast.

Yes, Virginia, There

Adopting the theme "From the Sea to the Stars," Virginia's newest tourist attraction—the Virginia Air and Space Center and Hampton Roads History Center—opens in April as a celebration of nearly four centuries of exploration in the Hampton area.

NASA's own roots run deep in Hampton's history. The National Advisory Committee for Aeronautics (NACA), the space agency's predecessor, established an aeronautical experimental station at Langley Field in 1917, and the Langley Research Center has been a pioneer in aerospace research ever since. Langley scientists played an important role in the Mercury, Viking, Gemini, Apollo and Shuttle programs, and the first Mercury astronauts trained there. Currently, Langley is involved in projects ranging from the National Aero-Space plane to Space Station Freedom.

In 1984, during the planning of Hampton's 375th Anniversary, officials realized that the city lacked a museum commemorating its history. Led by Mayor James Eason, museum supporters contacted NASA officials about a possible joint project. Coincidentally, Langley was in need of a new Visitor's Center outside the gates of its high security complex, and so NASA signed on: In return for Langley's contribution to the operating budget for the Virginia Air and Space Center,



Workers prepare exhibits for the Museum's official opening in April.

the Center will continue Langley's aerospace education and outreach programs.

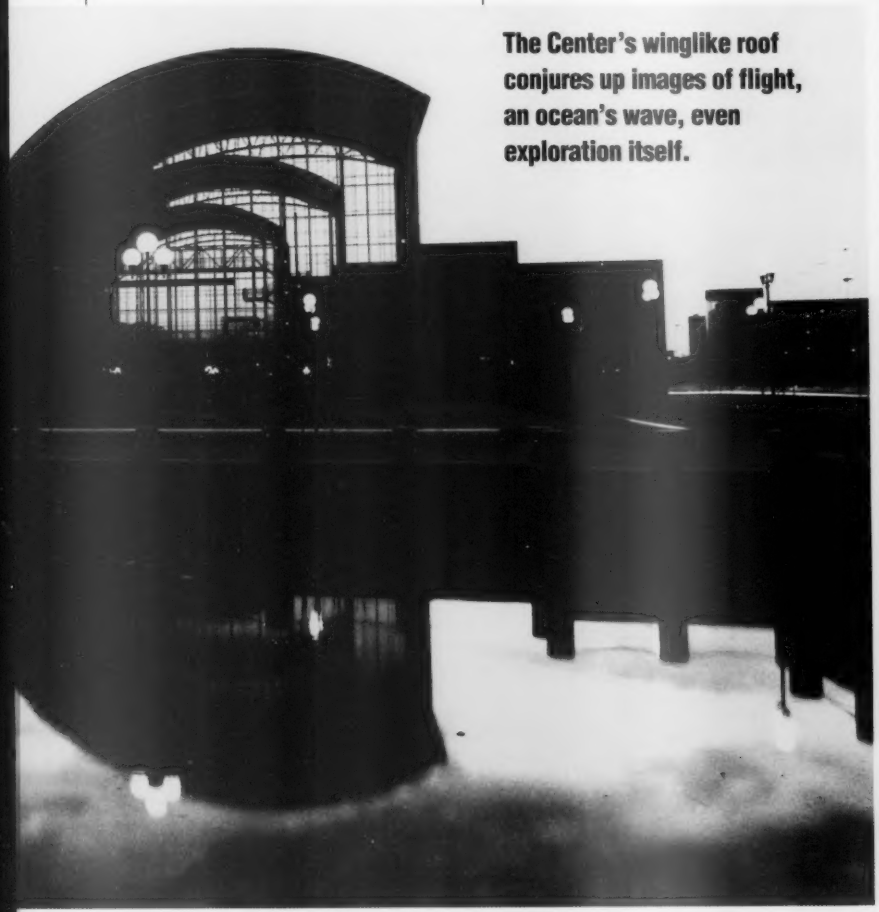
Jeannette Petrolia, Director of Development at the Center, praises the "tremendous help" that NASA has provided: "NASA and the Center have had a good working relationship for the past six years." As a result of that relationship, the Center also was able to establish close ties to the Smithsonian Institution, which is loaning artifacts for exhibits.

The 110,000 square-foot Center is housed in an impressive glass and brick building nine stories high. An observation deck offers panoramic views of the Hampton waterfront, where in the distance one can view the historic Civil War battle site of the Monitor and Merrimac, the ironclad forerunners of the great steel ships stationed in nearby Norfolk.

Jeannette Petrolia compares the Center to other museums: "So many museums look as though they were built in black boxes. They don't enhance the environment. The design of this Center *does* reflect its downtown environment. Its winglike roof conjures up images of flight, an ocean's wave, even exploration. It definitely reflects the story of Hampton Roads."

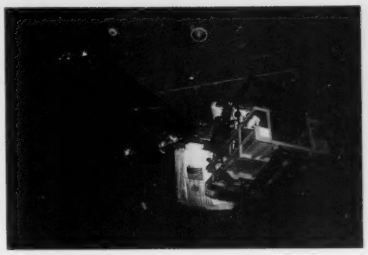
On exhibit inside the Center are displays of a 12-foot wind tunnel, a Viking Mars Lander and a large scale model of the Space Shuttle. A temporary exhibit connected with 1992's International Space Year opens in June.

Other more permanent exhibits will be designed around historical items loaned by NASA, the Smithsonian and the military. Along with the Apollo 12 Command Module, the Center will feature other NASA artifacts such as the



The Center's winglike roof conjures up images of flight, an ocean's wave, even exploration itself.

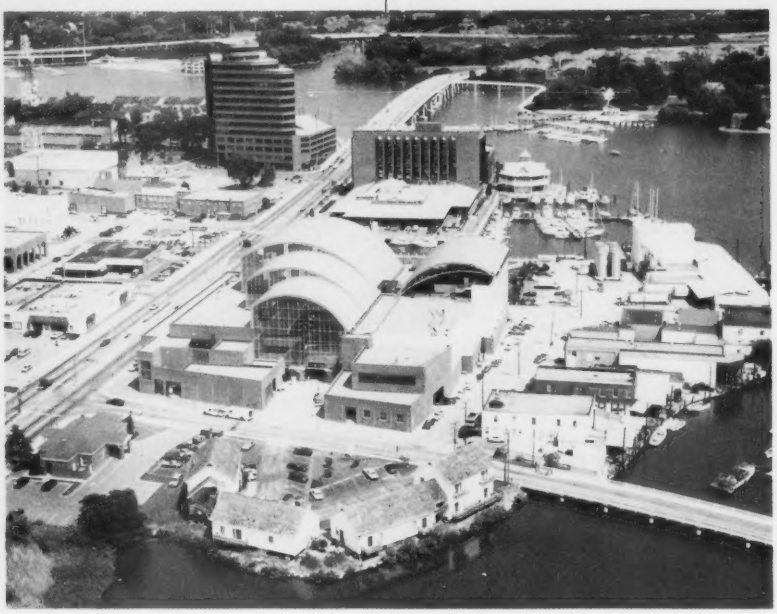
Space artifacts are delivered to Virginia's newest tourist attraction.



is a Space Museum

It's in Hampton, and it's open for business this spring.

by Bertram Ulrich



Bird's eye view of Virginia's new Air and Space Center.

spacecraft hatch from the Gemini 10 Mission, a Convair F-106B Delta Dart, a Mercury spacecraft and a lunar sample from the last Apollo mission. From the top of a 60-foot gantry, spectators will be able to view a Grumman American Yankee used for spin research by NASA.

An F-84 fighter jet on loan from the armed services also will be displayed in the gantry area, along with another dozen or so spacecraft and aircraft, including a YF-16 tactical fighter. The Smithsonian has loaned the original Great Aerodrome designed by Samuel P. Langley in 1903, which was at one time considered to be the first man-carrying airplane in history.

The Virginia Air and Space Center aims both to entertain and educate. The Center's 300-seat IMAX theater will show movies such as "The Dream is Alive" on its five-story projector screen. The building also houses classrooms and conference areas, and teachers will be able to take advantage of a Teacher Resource Center replete with computer software, audiovisual materials and publications. Special services will provide the public with school programs and field trips.

Although NASA has played a large part in the project, it has not been the only guiding force. Hampton Mayor James Eason and the late Tom Chisman, former President of the Air and Space Center, were instrumental in rallying public support. According to A. Lewis Allen, Chairman of the Board's Development Committee, Eason deserves much of the credit for forging a closer relationship among NASA, the Smithsonian and the military. The energetic and enterprising Chisman, meanwhile, used his exceptional organizational skills to get funding off to a head start, and his enthusiasm for the project was infectious. Under his leadership, the Center reached its $29.7 million goal on schedule. Local communities, foundations and corporations were generous in their support of the nonprofit institution.

The public in particular responded to the idea of a local aerospace museum, says Gary Price, Director of External Affairs at Langley. The Hampton community feels great pride and respect for this "birthplace of aerospace," says Price. "In essence, the community built a $30 million museum to honor the area's accomplishments in air and space."

The community was more than just interested, say project organizers. The Junior League, Young Astronauts, women's clubs and other local groups mustered community spirit by throwing beach parties as fundraisers, and raising money for the Center became "the social thing to do."

Community members clearly are proud of their latest attraction. Along with the new Hampton Roads History Center, which displays artifacts dating back to Hampton's first settlers in the 1600s, they hope it will enlighten not only Virginians but all those interested in the excitement of air and space travel. •

Bertram Ulrich is Fine Arts/Graphics Coordinator in the Office of Public Affairs.

The Virginia Air and Space Center, open seven days a week, is a 45-minute drive from either Williamsburg or Virginia Beach. Admission for all exhibits and the IMAX theater is $6.00 for adults and $4.25 for children. Excluding the IMAX theater, admission is $3.00 for adults and $1.50 for children. For more information, contact the Center at (804) 727-0800.

TUNING IN TO NASA Select

Since the sign-on of a regular program schedule last July, NASA Select's audience has grown considerably, with cable systems adding Select to their distribution systems; satellite dish owners tuning in to the service; and educators taking advantage of materials suitable for classroom use.

Letters...do we get letters!!!

Since "Launching the School Year with President Bush," produced and aired by Select last September, NASA has heard from viewers in 48 states. David Heller at the University of California, Davis, wrote to "applaud" our efforts, while Joanne Guida of Suburban Cablevision in East Orange, New Jersey said that "as a cable system, we service nearly 400 schools and sponsor a project called Cable in the Classroom. The teachers in our area are most interested in the programs offered by NASA."

The Detroit News had this to say about NASA Select in an article about our 'Space Age Channel': "...if you're into astronauts, rocket launches, shuttle flights and space walks, it's a trip."

The reviews are in: NASA's new TV programming is a hit!

Karl Buelterman of Cincinnati, Ohio agrees. He wrote to say that after months of pleading with his local cable company to add NASA Select to its line-up, he cancelled his cable subscription and purchased a satellite dish. "I have not regretted it," he says, "I watch Select constantly...your programming is fantastic."

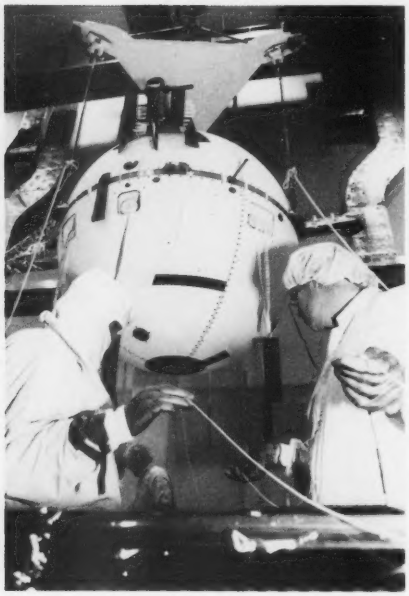
Although Mr. Buelterman was not successful in getting his cable system to carry Select, an increasing number of systems across the country are. Of special note is the fact that the Brooklyn-Queens Division of Times-Warner's New York City Cable Group—the second largest system in the country—made Select part of its line-up on January 1 (channel 84).

Colleges and universities with satellite receiving capabilities are also discovering Select and distributing the signal throughout their campuses. Butler University in Indianapolis, Indiana wrote to tell us of "extensive use" of our programming. At the University of Wisconsin at Superior, NASA Select is transmitted throughout the academic buildings and residence halls. •

KENNEDY

All Strung Out

This summer's STS-46 Shuttle mission will include a demonstration test to prove the capability to safely deploy, control and retrieve the Italian Space Agency's Tethered Satellite System (TSS). A milestone in the processing of the TSS was reached at Kennedy in January when the flight tether—which has the approximate diameter of a pencil lead—was mated to the spacecraft and the last several feet of 15 miles of tether were wound onto the reel. During the STS-46 mission, the TSS spacecraft will be unreeled and deployed about 12 miles from the orbiter Atlantis. Besides demonstrating the tethered satellite concept, the spacecraft will be used to conduct electrodynamic science investigations. On a later mission, the tether will be deployed downward to allow aerodynamic and wind tunnel-type testing in the region of the atmosphere 50-75 miles above the Earth. •

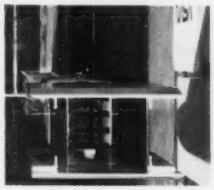


Kennedy workers mate the flight tether to the Tethered Satellite System spacecraft and wind the tether onto its reel in preparation for this summer's test flight.

LEWIS

To Be Seen, But Not Heard

Lewis recently completed tests on a Pratt & Whitney mixer ejector nozzle intended to cut engine noise without reducing performance. The new nozzle concept, which was tested in the Center's 9 x 15-foot Low Speed Anechoic Wind Tunnel, combines hot exhaust gas with cool air drawn in from the atmosphere. The result: lower jet temperatures and reduced noise.



The mixer ejector nozzle: lower temperatures, quieter engines.

NASA and industry engineers are generating a noise data base on a variety of nozzle concepts for possible use in designing tomorrow's High-Speed Civil Transport. •

STENNIS

A Winning Pair

Engineers at Stennis have successfully tested a pair of high-pressure turbopumps—the first time the new oxygen and hydrogen pumps have been tested together.

The turbopumps, which are designed to deliver liquid hydrogen and liquid oxygen to the main combustion chambers of the Space Shuttle Main Engine, were run simultaneously at 100 percent power for two seconds. The new pumps are intended to be more durable in order to save time and money when they are removed for maintenance and repair. The first of the advanced pumps is tentatively scheduled to fly on a Shuttle main engine sometime in 1994. •

JPL

When Bigger Is Better

In an age when most technology is going in the direction of microchips and minirovers, the Jet Propulsion Laboratory is building its largest flight structure ever: the 40-foot-long Shuttle Imaging Radar-C antenna, which will fill the entire cargo bay of Space Shuttle Endeavour when it rides into orbit in October 1993. According to Mike Sander, manager of the SIR-C payload project, the purpose of the mission is to test and refine the antenna's design before committing to the final concept for the Earth Observing System (EOS) synthetic aperture radar. SIR-C will be the most sophisticated civilian imaging radar system ever to study the Earth. As the first instrument to acquire images at multiple wavelengths and polarizations simultaneously, SIR-C will see below the surfaces of deserts to reveal ancient channels and riverbeds, and will be able to look "through" treetops to expose the condition of tropical and boreal forests. Plans call for the antenna structure to be fully assembled for system integration and testing this spring. •

JOHNSON

New Space Station Facilities Dedicated

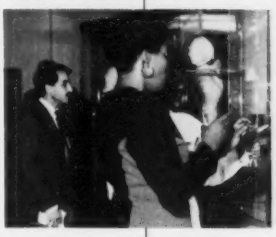
Two new facilities critical to the Space Station Freedom program were dedicated in February at JSC. The Space Station Control Center will be the focal point for coordinating operations onboard Freedom with control centers around the world. The 102,000-square-foot facility will house mission controllers and ground support personnel providing 24-hour support for the orbiting station. The Space Station Training Facility will be responsible for training flight crews as well as ground support personnel. This addition to the former Skylab training facility provides a total of 30,000 square feet of floor space for space station training. The facility is expected to be ready for training simulations in March 1995. •

JSC's new Space Station Control Center (above) and Space Station Training Facility (above right), were dedicated in February.

AMES

Visitor Center Gets a New Look

The Ames Visitor Center is now a full-time public facility with regular changes in exhibits, informational material and new, permanent exhibits. Housed in a former hypervelocity flight facility, the new Visitor Center showcases the unmanned HiMat test craft, the most maneuverable flight vehicle ever built, along with a model of the space station and a U-2 spy plane. The first West Coast display of the "Science in Depth" exhibit presents a combination of photography, holography, sculpture and computer graphics, with subject matter ranging from the mathematics of chaos to complex airflow around flight bodies. These and many more exhibits are designed to show the range of NASA and Ames research to the public and to students. •



GODDARD/WALLOPS

Up, Up and Away

Wallops technicians reported in February that two NASA scientific balloons in the Antarctic have set duration records for balloon flights of major scientific payloads. The two balloons, one carrying the Magnetic Passive Isotope Experiment (MAGPIE) and the other carrying the High Resolution Gamma-Ray Spectrometer (HIREGS), flew for nine and 14 days respectively, circumnavigating the South Pole. Both were retrieved in good condition.

The balloons used .0008-inch-thick polyethylene envelopes—about the thickness of ordinary sandwich wrap. The MAGPIE balloon was launched December 16 and flew at 129,000 feet until it was retrieved on December 26. The HIREGS payload, which like the MAGPIE weighed 3,750 pounds, flew at an altitude of 130,000 feet from January 10 through January 24. The average flight time for scientific balloon missions is from 12 to 24 hours. The NASA Balloon Program is managed by Wallops. •

LANGLEY

Top Spin

Langley's 20-foot vertical spin tunnel will undergo a major upgrade beginning this month. The renovation project will have three main phases: a motor upgrade to boost horsepower from 400 to 700; a fan replacement, which will provide the capability to change the speed of airflow in the tunnel; and a complete rotary balance system replacement. When the project is complete, says spin research group leader Raymond Whipple, "We will have the best spin tunnel in the world." Nearly every U.S. fighter, light bomber, attack plane and trainer has been tested in Langley's spin tunnel. Current work includes tumbling research, X-31 support and testing of the F-16 C and D models. •

Our school system is in immediate need of a drastic overhaul, and we who depend on the next generation to have technical and engineering skills are the ones who will have to figure out how to do it.

A Pizza and a Comic Book

by Dian L. Hardison, KSC

I approached my second year of mentoring without a great deal of enthusiasm. The first experience had been...well, not a disaster, but certainly not very productive. The boy and I hadn't had anything in common; there was no way to "relate." I knew better than to try to discourage his ambition of becoming a basketball star, even though he was short for his age. My attempt to get him to see beyond an athletic career—"even basketball stars have to retire"—had been met with the adolescent's typical disbelief that he would ever get old.

So I had no great expectations. Mainly I had volunteered out of a conviction that there was a problem, and that as an engineer I was best suited, and even had an *obligation,* to fix it.

My sixth-grade "mentee" had been identified as "not performing up to her potential." At our first meeting she showed a ready grasp of technology and an easy and outgoing personality, which made me wonder why she was having problems in school. Eventually we got around to the subject of "what do you want to do when you grow up?"

Barbara had a half-hearted notion of being a nurse, or a legal secretary. Or maybe even a veterinarian's assistant. "Why not go ahead and be a doctor or a lawyer?", I countered. "Or an engineer?"

She blinked at me. "I never thought of that."

And that, right there, was the biggest difference I could have made. Coming from a family where neither parent had a professional degree, it had never occurred to her that there were rewards for putting in effort at school; and with four younger brothers, her parents had little time to give her individual instruction. But, for a few hours of my time a week and the cost of an occasional pizza and a comic book, I tapped a perpetual motion machine: motivation.

There are, of course, other problems. Spending a day at school with Barbara, I was appalled at the conditions. Two and even three students had to share one book. Aside from the annoyance of having someone constantly reading over your shoulder and having to adjust your pace to the slowest member of the group, how are kids supposed to study when they can't even take the books home? Furthermore, all except a very few "advanced" classes were geared to the lowest common denominator—often sixth-graders who couldn't read. And every teacher I saw was so frazzled by overcrowded classes that they either punished the least whisper—no adult would tolerate a work environment like that!—or plugged in a videotape and called that a lesson.

Governments woefully announce that budget cuts are going to hurt education, in the hopes that we will, in desperation, agree to yet another tax increase. It's not schoolbooks or teachers' salaries that drain the education budget, however. It's the administrators, the endless layers of boards and commissions, and the new multi-million dollar buildings they procure for themselves while using the schools themselves as pawns. Visitors aren't welcome in these polished and panelled offices; you'll rarely hear anything about how big a portion of the education budget they represent. But anyone who looks hard will see where the money that's not being spent on students is going.

The school bureaucracy is in immediate need of a drastic and detailed overhaul, and we who depend on the next generation to have technical and engineering skills are the ones who are going to have to figure out how to do it. Local politics is one avenue for exercising our influence. And, as I found from personal experience, even one mentor and a few hours a week can make a profound difference.

However we address it, though, this is an issue that deserves all our attention. The system as it stands is ruining our future. •

Dian Hardison is an engineer at the Kennedy Space Center.

SPACE SHUTTLE LAUNCHES

• STS-49 Space Shuttle Endeavour's maiden flight will test all of the orbiter's basic systems during a seven-day mission highlighting the capture and repair of an INTELSAT-VI communications satellite which has been stranded in a wrong orbit for two years.

• STS-50 the first flight of Columbia following its refurbishment at Palmdale will carry the U.S. Microgravity Laboratory-1.

UPCOMING EVENTS

20 APRIL

AMERIFLORA'92
AMERICA'S CELEBRATION OF DISCOVERY

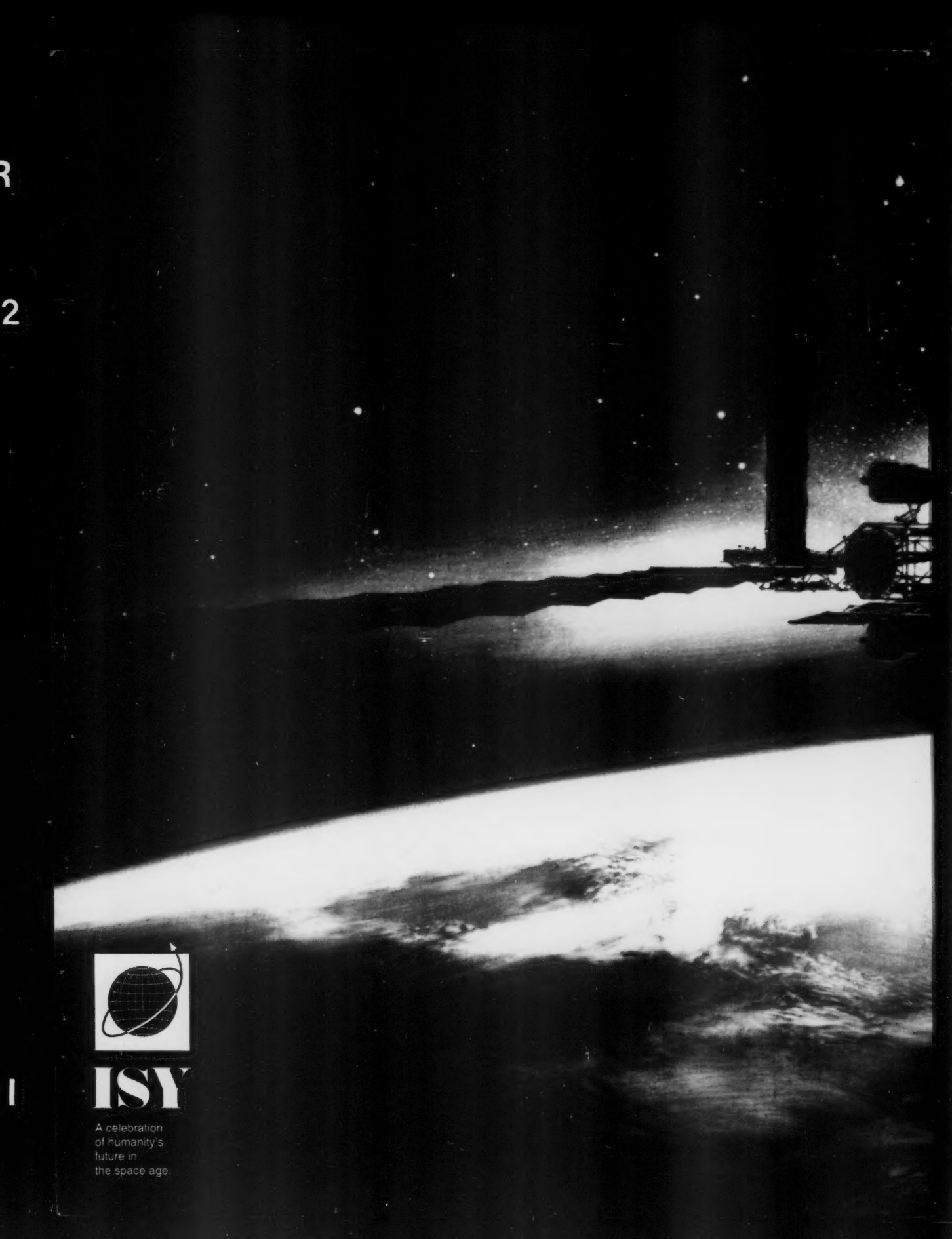
AmeriFlora '92 - "America's Celebration of Discovery" international exposition opens in Columbus, Ohio, through October 12.

4 MAY

Public Service Recognition Week begins.

IN OUR NEXT ISSUE

NACA/NASA:
Langley Research Center celebrates its 75th anniversary.



ISY

A celebration
of humanity's
future in
the space age.